MODEL AIRPLANE NEWS

Readers' Survey Sweepstakes $2500 IN PRIZES

THE WORLD'S PREMIER R/C MODELING MAGAZINE

48120

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from the Chicago Hobby Show!

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CONSTRUCTION

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- PAINT MILITARY MARKINGS
- WIRE MULTI-ENGINE ELECTRICS
- BUILD SCALE PILOTS

February 1999
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Did it really fly? see page 40

MODEL AIRPLANE NEWS

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PAGE 81

Model Airplane News Readers' Survey Sweepstakes

50 WINNERS!

ON THE COVER: main image—John Tanzer's Sopwith Baby is an excellent WW I subject. John brings it to life in 1/4 scale. Inset—Faye Stilley reconstructs the first R/C ornithopter.

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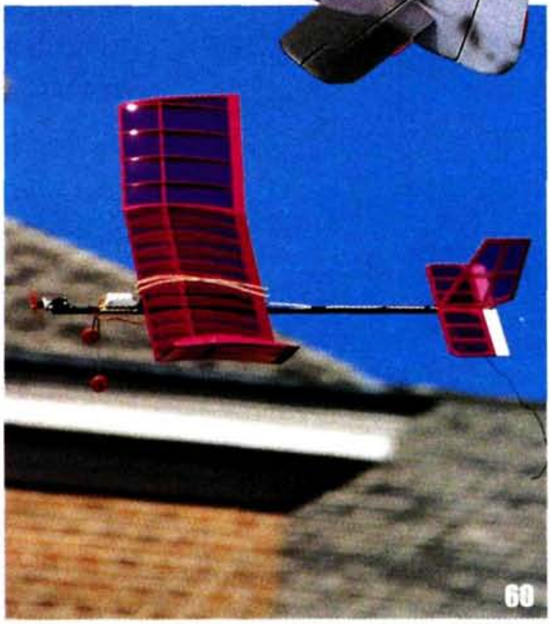

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EDITORIAL

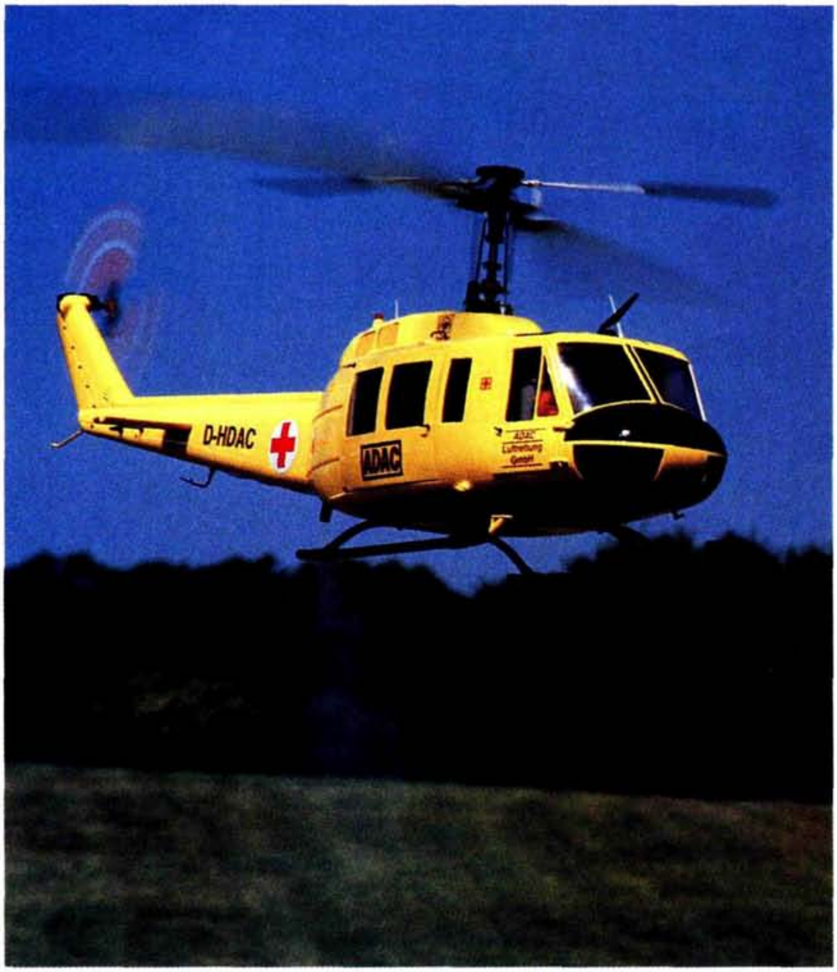
BY LARRY MARSHALL

What Do You Think?

I've gotten a lot of positive responses to my editorial, "Growing Old or Changing?" (December 1998) from both readers and the industry. It seems that I described what many people are seeing or feeling when I suggested that our hobby was once again becoming more diverse in the interests displayed by model aviation enthusiasts. Most see this diversity as a good thing; many feel it's the reason that we're seeing younger faces on the flightline. Others think the young faces are causing the diversity. In either case, it's a good thing, in my view.

But with these changes come challenges for model magazines. Some magazines specialize in a particular form of model aviation, and for those readers who do only one form of modeling, these may be appealing. What's gained are more pages on a particular topic; what's lost is the ability to learn from people doing different things so that the techniques can be applied to what you're doing.

One of the cornerstones of *Model Airplane News* editorial policy over the years has been that many modelers—maybe most modelers—do not specialize in one particular niche; we assume that most people who read our magazine participate in several areas of model aviation throughout the year, enjoying each form of flying, knowing that there's no single "best" way to enjoy model aviation.



Joe Howard's gorgeous Vario UH-1 Huey was only one of many helicopters at this year's Hirobo Cup.

Are we correct in this view? A reader called yesterday and he underscored this view. He called to renew his subscription and to tell us how much he liked the magazine. He said he flew a lot of giant-scale planes powered by gasoline engines, multi-cylinder radials, etc. He told me of his Spitfire and his ⅓-scale Sopwith Pup and several other birds that are near and dear to his heart. Then he told me of the fun he'd been having with Norvel engines—how he'd just finished up a small L-19 that was cute as a bug. He told me how he and some other guys were pylon racing Q-Tees using Norvel engines. In other words, this guy was flying airplanes, big and small. He made the point of saying that one of the things he liked most about *Model Airplane News* was that we "cover it all."

Well, the truth is, while we try to "cover it all," that's a difficult goal to achieve, and we need your help in making decisions. Tell us what you like. We'd love to see a flood of letters from our readers telling us what sorts of modeling they do, want to do, or just want to read about others doing. Do you fly giant scale; do you fly small planes? Are you a helicopter flyer; do you fly free flight, possibly when winter forces you indoors? Do you fly any electric-powered models; do you fly with gas and/or glow engines? Do you prefer scale or sport planes? Do you fly ARFs, kits, or scratch-built airplanes? We'd like to hear what you're doing, what your club is doing, and what kinds of activities your club has planned for the upcoming year. After you finish writing that letter, I urge you to take part in our Readers' Survey; see page 81 for details. With your help, we can better understand what excites you and what we should be doing with the magazine.

HIROBO CUP, SCALE MASTERS AND ORNITHOPTERS

We bring you two first-class events this month, put on by two first-class organizations. Scale Masters was again a big success. The pilots always rave about the organization and the good time they have whenever it's held in Columbus, and 1998 was no exception. Once again, Jerry Nelson provides the play-by-play and great photos.

I went down to the Hirobo Cup this year. It was my first time there, but I'm looking forward to returning, as it was a great event and Altech did a great job of hosting a fun event for helicopter newbies (like me) and experts alike.

Aviation is what it is because of people with vision. Percival Spencer had a vision of a bird-like flying machine, and he made that vision a reality. We're fortunate to be able to bring you Faye Stilley's restoration of that grand machine; we hope you like it.

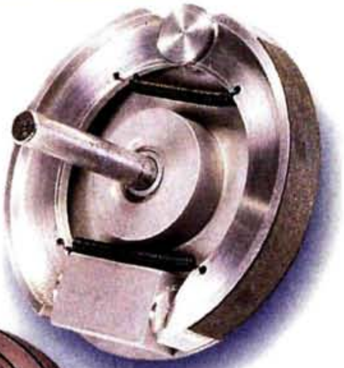
New products or people behind the scenes; my sources have been put on alert to get the scoop! In this column, you'll find new things that will, at times, cause consternation, and telepathic insults will probably be launched in my general direction! But who cares? It's you, the reader, who matters most! I spy for those who fly!

AIR SCOOP

BY CHRIS CHIANELLI

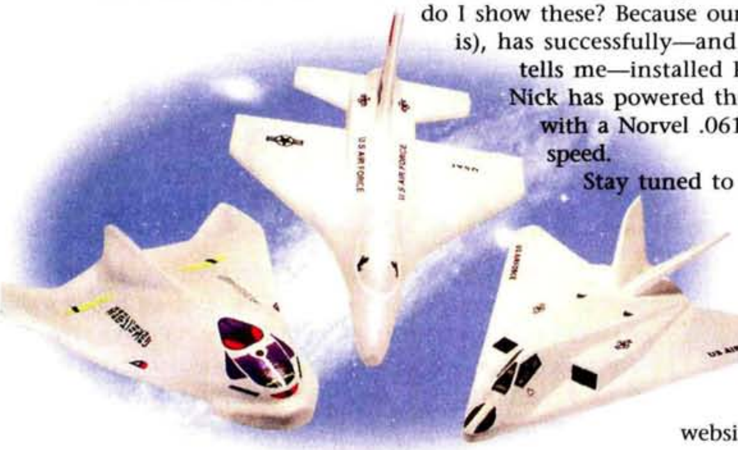
Chicago Show Special

Brakes fit for a giant



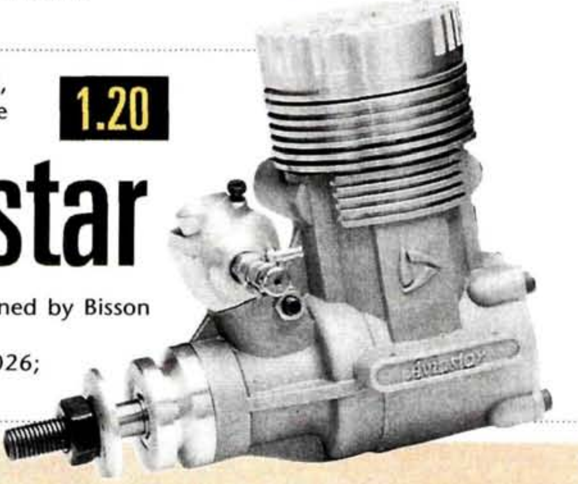
Here's a look at Robart's precision hydraulic brake system that you giant-scale guys will go nuts over. Because it's hydraulic, the brakes can be activated by a dial or a slide lever on your transmitter, so braking can be fed in progressively. I held a sample in my hands, and I can tell you that these piston-activated, twin-shoe drum types are finely machined units.

Also shown are Robart's F-16, F-117 and UFO foam gliders. Why do I show these? Because our hero, Uncle Nick (Ziroli that is), has successfully—and with very little effort, he tells me—installed R/C control in the F-16. Nick has powered the mini Fighting Falcon with a Norvel .061. Nick always did like speed.



Stay tuned to *Model Airplane News* for a feature on Nick's conversion, and for info on the Robart products, contact Robart Mfg., P.O. Box 1247, St. Charles, IL 60174; (630) 584-7616; website: www.robart.com.

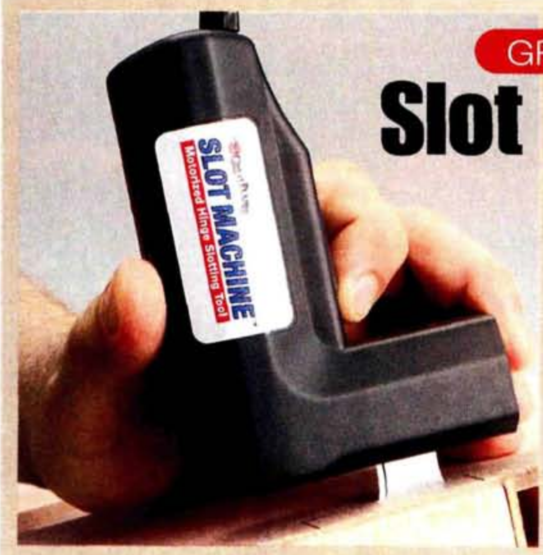
1.20 Aviastar



I got a really close look at the new Aviastar 1.20, and it is one finely machined, robust engine. It looks "right," if you know what I mean. Renowned engine expert and author Dave Gierke has worked closely with the manufacturer to develop this engine, and initial reports are very promising. Its features include: O-ring sealing in six places; one-piece investment-cast crankcase; machined carburetor with twin needle valves and oil-capturing piston design with compression ring. Optional mufflers have been custom designed by Bisson Custom Mufflers. Rumor has it that prices are very attractive.

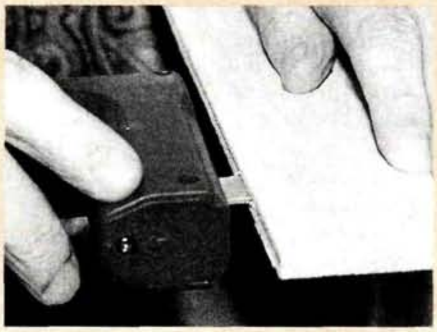
Dave Gierke Flying Models Inc., P.O. Box 83, Bowmansville, NY 14026; (716) 681-4840.

GREAT PLANES Slot Machine



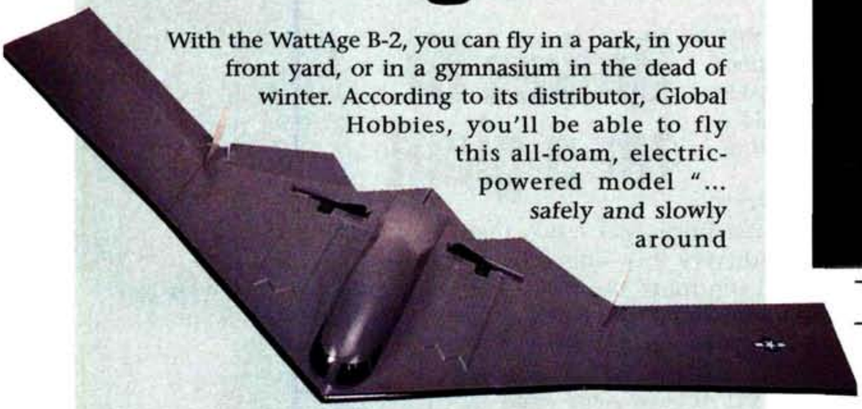
I don't know about you, but nothing makes me turn off the workshop lights faster while mumbling "Forget it; I'll tackle it tomorrow" than the task of hinge-slot cutting. It's the single task I hate most in this otherwise wonderful hobby of ours. I tried this little electric gadget on soft, medium and hard balsa at the recent Chicago Hobby Show, and I can tell you firsthand that it works. Not only does it work, but it also turns a tedious task into an enjoyable one while taking hinge slotting to new heights of accuracy.

The two contra-oscillating blades—supplied in regular for CA hinges and thicker for nylon hinges—are perfect for the job. In my humble opinion, the Slot Machine is right up there with CA glues and servo-reversing; after using them, you wonder how you ever got along without them.



Great Planes Model Distributors, 2904 Research Rd., Champaign, IL; (800) 682-8948; fax (217) 398-0008. website: www.greatplanes.com.

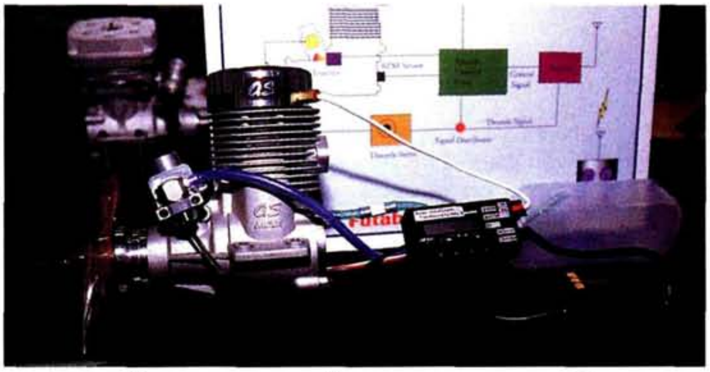
WattAge B-2



With the WattAge B-2, you can fly in a park, in your front yard, or in a gymnasium in the dead of winter. According to its distributor, Global Hobbies, you'll be able to fly this all-foam, electric-powered model "... safely and slowly around yourself and land almost like a big butterfly." The ARF B-2 features: twin, electric micro-motors and props; a full hardware pack; and easy-to-follow pictorial instructions with flight-prep tips. The B-2 costs only $39.95 and may be purchased with a speed controller or servos or a Hitec Focus 3-channel radio—or any combination thereof.

Also shown here is the new AP Hornet .09 glow engine. The Hornet is available in stunt and R/C versions with a twin-needle carburetor. Both versions feature a rear-mounted, drum-style muffler that can be rotated to suit your exhaust-exit preference.

Global Hobbies, 18480 Bandilier Circle, Fountain Valley, CA 92728-8610; (714) 964-0827; fax (714) 962-6452.



Electronic Fuel Injection

That's right, the E.F.I. (electronic fuel injection) system was specially designed for our 2-stroke glow engines and is a collaborative development effort of O.S. and Futaba. The system's design is basically the same as those found on full-size automobiles. Because of a model airplane's constantly changing flight attitude, the optimum fuel-mix and mixture quantity the engine calls for constantly changes, too. With information received from an rpm sensor and a temperature sensor, the large-memory electric control unit can instantly adjust to the engine's needs, even under very severe conditions—changes of load, abrupt changes of rpm, for example. By controlling the opening and closing of a solenoid valve, the electronic control unit instantly regulates the quantity of fuel going to the carburetor. According to the manufacturer, since all data on fuel control is preprogrammed, it will allow even first-time model engine users to successfully start and run one.

Great Planes Model Distributors, 2904 Research Rd., Champaign, IL; (800) 682-8948; fax (217) 398-0008; website: www.greatplanes.com.

ARF Ryan

This ⅙-scale Ryan PT-20 is just one of Airplane Model Workshop's (AMW) beautiful ARFs. The line features beautifully crafted and finished gelcoated fuselages and covered balsa wings and even includes stranded rigging wire and fittings. PT-20 specs: wingspan—64 inches; wing area—640 square inches; weight—5.7 pounds; engine required—.36 to .50 2-stroke, or .48 to .52 4-stroke. Oh, I almost forgot: the floats are also available from AMW.

Hobby Supply South, 1720 Mars Hill Rd., Ste. 8365, Acworth, GA 30101; (770) 974-0843; (770) 974-6243.

Ott-Lite

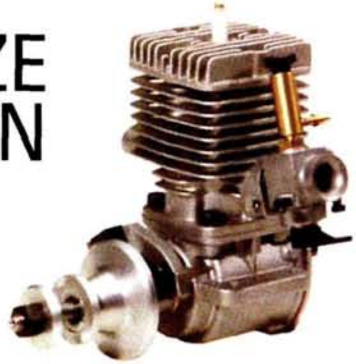
When it came out in the mid-'70s, the Top Flite P-40 was one of my first scale projects. I worked on it all winter, but when I took it outside, the natural sunlight turned my beautiful olive-drab fighter into something that more closely resembled a flying salamander. The green I mixed was off—way off!

Ott-Lite replicates natural daylight indoors—without excessive heat—to allow colors and the tiniest details to be seen accurately without the harsh, eyestrain-causing glare you get from most high-intensity indoor lighting.

The Ott-Lite lamps are available in desk, floor and clamp-on versions, and screw-in and fluorescent-tube-style bulbs are also available.

Ott-Lite Technology, 1214 W. Cass St., Tampa, FL 3306; (800) 842-8848, ext. 350 (ask for Bruce Bernstein).

40-SIZE IGNITION



Here's a very interesting item I found at the show but is not yet being imported into this country—but certainly should be. It's the Italian Compagnucci .40 gas/ignition engine. I did get to see the company's ready-to-run, 1/8-scale car running with this engine, and it performed extremely well, to say the least. Compagnucci is looking for an American distributor for its entire line, which also includes a boat version of this engine.

Compagnucci S.p.A. Wire Products Engineering, Italy; tel. +0731-245999; fax +0731-246266.

JR DataSafe PC interface

JR's new DataSafe PC interface software allows owners of the company's XP8103, 10X, 10S, 10Sx and 10SxII radios to upload and download model memory between them and any PC. Developed by the Topper Co., DataSafe is compatible with Windows 95, 98 and NT operating systems and comes with the new JR PCM 10X 10-channel radio system. The number of program parameters you can store is limited only by the space on your PC's hard drive. Just think; in the not too distant future, maybe you'll be able to have the program parameters of your favorite aerobatic or heli pilot downloaded into your radio from the Internet!

Distributed by Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL; (217) 355-9511; website: www.horizonhobby.com.

SIG Kadet ARF

Some are of the opinion, and I concur, that ARFs are a positive force in our hobby and, moreover, are here to stay. The recent introduction of an ARF by a company such as Sig is strong evidence that this feeling is fact.

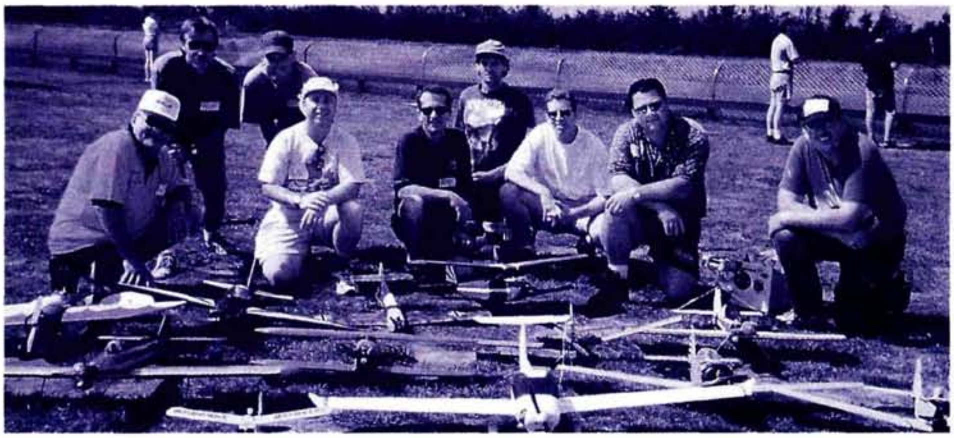
Like the built-up Kadet, the new Kadet LT-40 ARF features a true Clark-Y airfoil for better penetration and roll rate. The LT-40 is completely built up from Sig's high-quality balsa and plywood and covered with Oracover. Name-brand hardware such as Du-Bro wheels, spinner and fuel tank is included. My favorite feature is the LT-40's size—a bit larger than a standard trainer. With its 70-inch wingspan, 900 square inches of area and 14 to 15 ounces/square foot of wing loading, the Kadet LT-40 should be one smooth, predictable and super-forgiving flier. Recommended engines: .40 to .46ci 2-stroke, or .40 to .54 4-stroke.

Sig Mfg. Co. Inc., P.O. Box 520, Montezuma, IA 50171-0520; (800) 524-7805; (515) 623-3922; fax (515) 623-3922; website: www.sigmfg.com.

AIRWAVES

Our readers write back

WRITE TO US! We welcome your comments and suggestions. Letters should be addressed to "Airwaves," MODEL AIRPLANE NEWS, 100 East Ridge, Ridgefield, CT 06877-4606 USA; email man@airage.com. Letters may be edited for clarity and brevity. We regret that, owing to the tremendous numbers of letters we receive, we can not respond to every one.



SMALL IN CANADA

Congratulations on your fine article on SMALL in the November issue of *Model Airplane News*. I want to thank you for helping spread the word of SMALL. For the last two years, I've put on the only SMALL event in Canada.

I was the events director for our club—the Stetson Flyers—and that alone gave me the experience, and last year I started the Mosquito Squadron of SMALL event. I was able to get the word out to Randy Randolph who was kind enough to mention our event in his column in *Flying Models*.

This year, the Mosquito Squadron again took to the skies. The event went extremely well, with fine weather, and lots of fun was had by all. Our event even got some sponsorship from our MAAC zone director, Ross MacEwan.

I've heard you are somewhat familiar with many folks up in this neck of the woods. I would appreciate anything you can do for us SMALL steppers north of your border.

KEN PARK
Nepean, Ontario, Canada

With small plane fever seemingly spreading everywhere, the time is right for more SMALL squadrons to be formed. It's unfortunate that the SMALL organization doesn't have a way of supporting squadron formation. I applaud you and your Mosquito Squadron buddies for forging onward.

It's true also that I do know a number of people who live in your area, as I lived there for six years. Ross was president of our club when I joined back in ... well, a long time ago.

Thanks for all the photos you sent. I chose to publish the one that includes so many smiling faces.

LM

CULVER V DESIGNER

I hope to design and then build a ¼-scale model of the Culver V. Associate editor Debra Sharp put a 3-view of the Culver V in the October issue of *Model Airplane News*. I have drawn the tail feathers and am working on the fuselage. I've tried some websites but have had no luck locating any info on the Culver or the Culver Aircraft Co. Any suggestions? [email]

BOB KIBBEY

The Culver Aircraft Company made light aircraft before, during and after WW II. One of their claims to fame was building "piloted drone" aircraft for antiaircraft target practice. These small aircraft were intended to be radio controlled during use but also had complete cockpits so that a pilot could fly them cross-country. The two main examples were the PQ-13 (derived from the prewar Cadet) and PQ-14.

Typical of Culver designs, the Culver V was a small, trim aircraft with retractable, tricycle landing gear. It was produced immediately after WW II and was powered by a 90hp Continental engine. It surely has the most pleasing lines of any of the Culver series. As for documentation, a quick check of Bob Banka's Scale Model Research website: imt.net/~ims/scale.html shows that he offers three photo packs. This should get your documentation off to a good start. Good luck with your project!

JIM RYAN

HEY, ONE WING'S LONGER THAN THE OTHER

Larry, the December cover is great, but it is still driving me nuts!

I've wasted a lot of time trying to figure out the camera angle at which Dave Rees's Plage-Court Torpedo was shot. The foreshortening one would expect of the far wing seems reversed, that is, the far wing seems considerably longer than the near. The rib spacing also scales at greater intervals. Careful study of the prop blur shows some possibility that it is left-hand rotation. In that case, it is possible to make an argument that the extra right-side wingspan is to counteract torque—but it's an awful lot extra! What happens when power is reduced, or stopped? Even considering that the transparency was flopped leaves us with the same puzzle—but in mirror image. It sure beats me. I wonder how many other readers you'll hear from. [email]

ROY CROUGH

It's amazing what cameras can do. Sorry we had you scratching your head so hard over something that's an optical illusion. I talked with Dave Rees (the builder) and he verified that the wings are 1) the same length and 2) the same area.

You're seeing the effect of the dihedral coupled with the fact that the wings are slightly swept. The result, at that particular orientation of the plane in the photo, gives the illusion that the right wing is considerably longer than the left.

You asked, "What happens when power is reduced, or stopped?" Well ... the plane continues flying, that's what. Dave's Torpedo ultimately flew out of sight at the Flying Aces Nationals. Sure is pretty, isn't it?

LM

PILOT PROJECTS

A look at what our readers are doing

SEND IN YOUR SNAPSHOTS. *Model Airplane News* is your magazine and, as always, we encourage reader participation. In "Pilot Projects," we feature pictures from you—our readers. Both color slides and color prints are acceptable. We receive so many photographs that we are unable to return them.

All photos used in this section will be eligible for a grand prize of $500, to be awarded at the end of the year. The winner will be chosen from all entries published, so get a photo or two, plus a brief description, and send them in!

Send those pictures to: Pilot Projects, *Model Airplane News*, 100 East Ridge, Ridgefield, CT 06877-4606 USA.

CLEARED FOR TAKEOFF

Scratch-built by Ed Hirschfeld of New York state, this Canadian Cornell was featured on the cover of the October 1998 *Model Airplane News* in a photograph taken at the World Miniature Warbird meet in Kirkwood, NY. The model is powered by a Zenoah G-38. Emile Cananello of Huntington Station, NY, sent in this photo and writes, "It flies as nice as it looks."

1/8-SCALE NORTHROP GAMMA

Barry Payne of Nowra, New South Wales, Australia, modified this Northrop Gamma model from an Aero Classics kit. The plane has a 72-inch wingspan, weighs 7 pounds, 8 ounces and is powered by a Laser .80 4-stroke with a Cline proportional-control fuel system. Barry added functional landing lights and finished the Gamma with MonoKote aluminum and Solarfilm aluminum panel lines, and he sprayed aluminum LustreKote on the wheel pants and cowl.

TWICE AS NICE

Retired airline pilot Maurice Johnson had always wanted to build a model of a Fairchild 24 because in 1939, he received his commercial pilot's license in one. He decided to build the Ikon N'West kit and painted the model to look like the full-size Fairchild he now owns. The 91-inch-span, 17-pound model is powered by a Saito 1.50, uses a Kraft radio for control and is covered with 21st Century Fabric and Rustoleum paint.

1/5-SCALE STOSSER

Tom Kilker of Baltimore, MD, designed and built this 83-inch-span Fw-56 Stosser and equipped it with a Super Tigre 3000 engine. Tom writes, "The heart of the model is a plywood box in the forward fuselage. The engine is bolted to the front of the box, and the wing is attached to the box via cabanes and struts. The aft fuselage, which is removable, is bolted to the rear [of the box], and the landing gear, a single piece of 1/4-inch-diameter piano wire, is wrapped around it." The Stosser is covered in Super Coverite.

LITTLE FIGHTER

This 1/12-scale combat Hawker Typhoon is the handiwork of Ron Daniels of Kitchener, Ontario, Canada. The 41-inch-span, 2.75-pound model has a rubber-mounted cannon and is powered by a Trinity buggy .05 electric motor on 7 cells and swings a Master Airscrew 11x9 prop. Ron writes that the Typhoon is his first electric design and that although it flies very smoothly at scale-like speeds, he plans to upgrade the power system.

PBY CATALINA

Jay Brown of Rogers, MN, built this Catalina from a G&P Sales kit, which included a fiberglass fuselage and foam wing. The 104-inch-span model has a water rudder and retractable landing gear and wingtip floats; it weighs 26 pounds and is powered by two Saito .91s turning Graupner 12x8, 3-blade props. Jay painted his Cat in seven shades of Hobbypoxy and added all the lettering and panel lines by hand. This photo was taken at the Greater Des Moines Aviation Expo in Ankeny, IA, and the 1/6-scale U.S. aircraft carrier in the background was used in the Expo's "Striking Back" show.

BLUE BIRDS II

Al Masters of Rocky River, OH, was inspired by Ken Willard's hand-launched, .10-size creation published in a 1978 issue of *Model Aviation* to create this O.S. .60-powered, 70-inch-span flight squadron. The four planes are joined with 1/2-inch-diameter fiberglass tubes, which also carry the air lines and leads for the six servos and Spring-Air tricycle retracts. The model has successfully flown off grass and hard-surface fields, and Al notes, "It was a real scratch-builder's nightmare that resulted in a fine performer."

FLYING TIGER

Victor Myszkiewicz of Edmonton, Alberta, Canada, scratch-built this 30-pound P-40 Warhawk using Nick Ziroli plans. It's powered by a 4.2 converted chainsaw engine turning a 22x10 Zinger prop and features flaps, foam wings, a sliding canopy and homemade retracts. Victor finished the P-40 with 3/4-ounce cloth and West System resin and adds, "The plane has had five flights to date and is a very scale-like flier."

AIR CAMPER

W.O. Weiss designed and built this 56-inch-span Pietenpol and outfitted it with Sky Scout-type landing gear (to handle rough fields), functional struts and homemade wheels and tires. Just like the original plane, the model doesn't have dihedral, so ailerons are necessary for control. Mr. Weiss notes that because of its concave airfoil, the model flies as though its flaps were always down. For power, the Pietenpol uses an O.S. .35 spinning a 10x5 propeller.

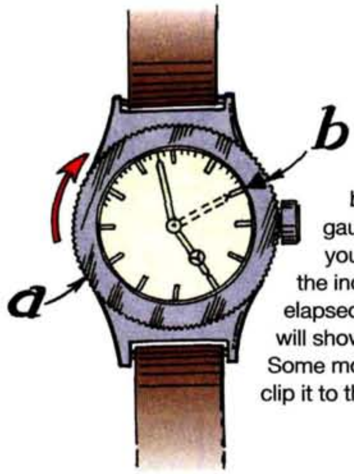
BELL 222

This helicopter was built by Emile Sheriff of Enterprise, AL. A Concept 30 and O.S. .32 engine are housed in the Funkey body; the rotor head is from a Hirobo shuttle; and it uses Robart mechanical retracts with homemade shock-absorbing struts. A JR PCM 10 provides control. Emile took this photo at the Bell Helicopter support center in Daleville, AL.

HINTS & KINKS

BY JIM NEWMAN

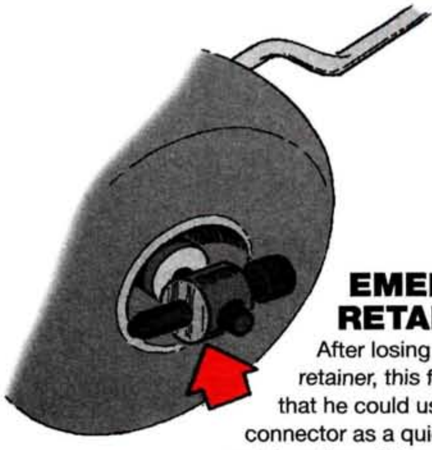
SEND IN YOUR IDEAS. *Model Airplane News* will give a free, one-year subscription (or one-year renewal, if you already subscribe) for each idea used in "Hints & Kinks." Send a rough sketch to Jim Newman, c/o *Model Airplane News*, 100 East Ridge, Ridgefield, CT 06877-4606 USA. BE SURE YOUR NAME AND ADDRESS ARE CLEARLY PRINTED ON EACH SKETCH, PHOTO AND NOTE YOU SUBMIT. Because of the number of ideas we receive, we can't acknowledge each one, nor can we return unused material.



TIME PEACE

A simple watch with a rotating outer bezel ring (a) can be used as your fuel gauge. In the example shown, if you know you can fly 12 minutes, rotate the ring until the index pointer is where 12 minutes will have elapsed (b). An occasional glance at your watch will show when you are approaching "bingo fuel." Some modelers buy an inexpensive watch and clip it to their antenna, where it can be easily seen.

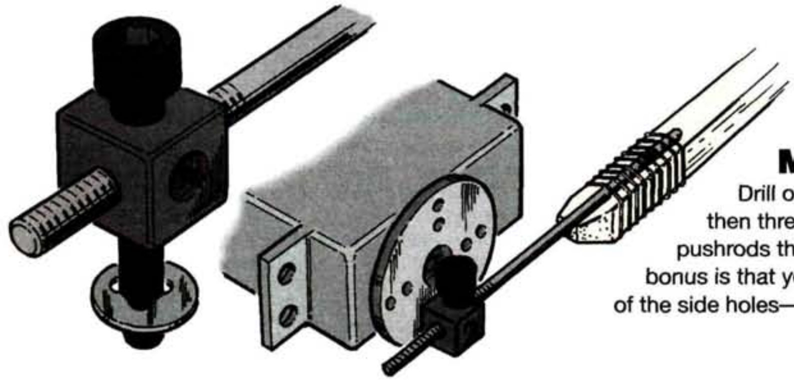
Ted Carl, Wayzata, MN



EMERGENCY RETAINER

After losing a wheel retainer, this flier found that he could use a pushrod connector as a quick fix so he could continue flying.

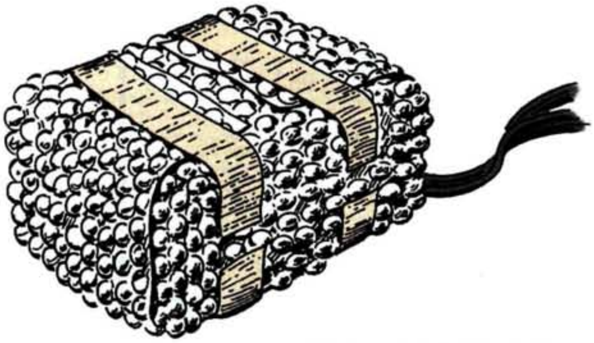
Gary Hannah, Orlando, FL



MULTI-WAY CONNECTOR

Drill out all four sides of your pushrod connectors with a no. 43 drill, then thread the four holes with a 4-40 tap. This allows the use of 4-40 pushrods threaded directly into the holes and locked with setscrews. A bonus is that you can mount a servo on its side, then use a setscrew in one of the side holes—no more fiddling with 90-degree Allen keys.

Phillip Wright, Charleston, WV



FOREVER BLOWING BUBBLES

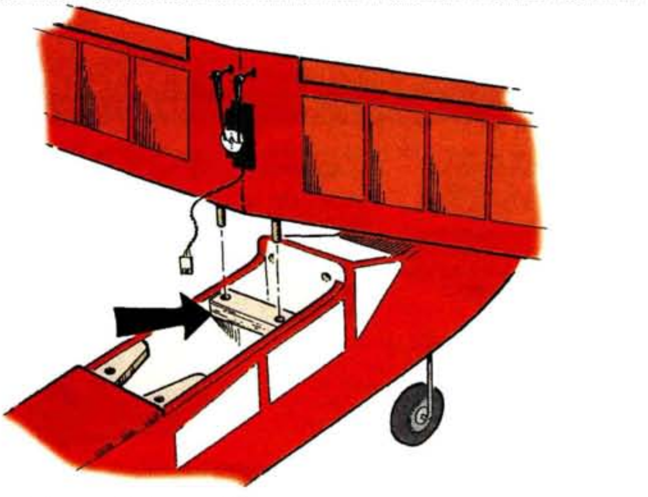
Wrapping your receiver in plastic bubble wrap will effectively protect it with a layer of non-vibration-transmitting air. Bubble wrap is inexpensive and available from parcel-shipping and office supply stores.

Ronald Brooks, Port Charlotte, FL

FILE CLERK

Copy, then clip out your "Hints and Kinks." Stick the individual hints to sheets of paper by subject and place them in plastic sheet protectors, if you wish. Make dividers from poster board so you can file clippings under subject headings in a cardboard file box from an office supply store.

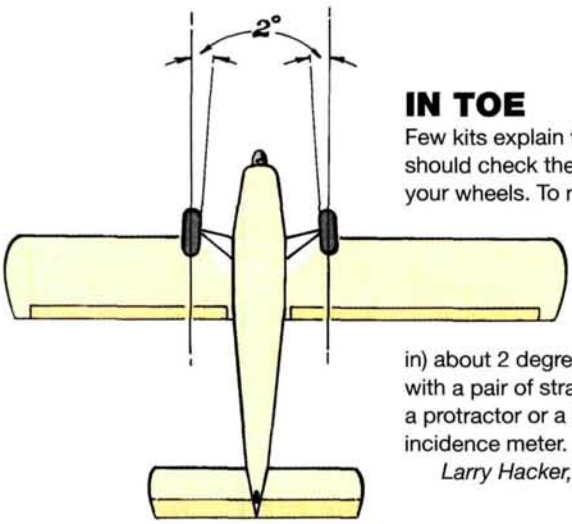
Douglas O'Leary, Magna, UT



STAND-UP WING

Glue a balsa block across your fuselage opening, drill it to match the wing leading-edge dowels, then plug your wing into the holes so that it stands up—hands free—while you plug in the aileron and flap servos. This works on high- and low-wing planes.

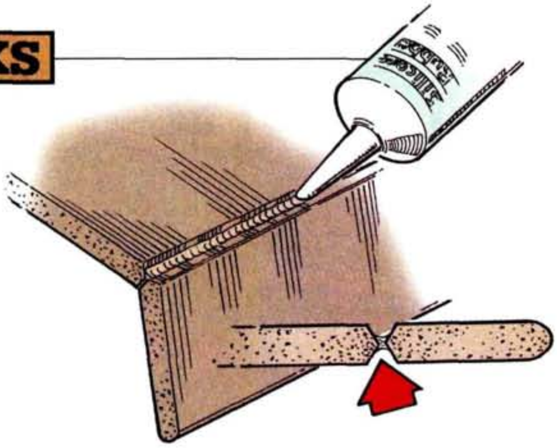
Michael Killion, Mesa, AZ



IN TOE

Few kits explain that you should check the alignment of your wheels. To maintain straight takeoffs, it helps if each wheel points inward (toes in) about 2 degrees. Check this with a pair of straightedges and a protractor or a Robart incidence meter.

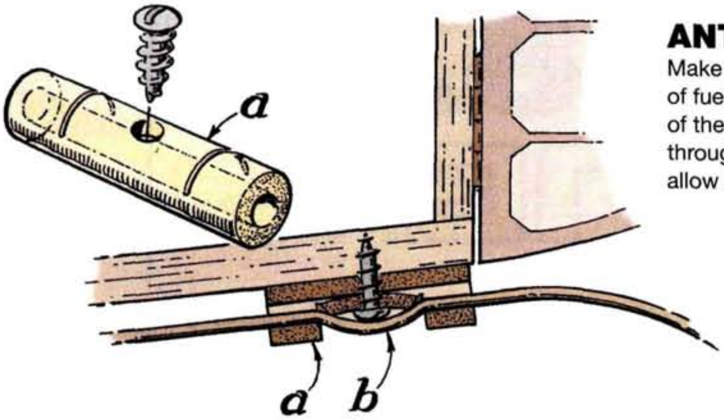
Larry Hacker, Mabelvale, AK



HINGE SEALS IN A TUBE

When your entire model is covered, you can create neat, aerodynamically efficient gap seals by deflecting the control surface to its limit, then running a thin bead of clear silicone rubber along its length, taking care to avoid the hinges. Smooth the bead on both sides with a wet tissue, wipe and leave to dry.

Les Mason, Santa Ynez, CA



ANTENNA TENSIONER

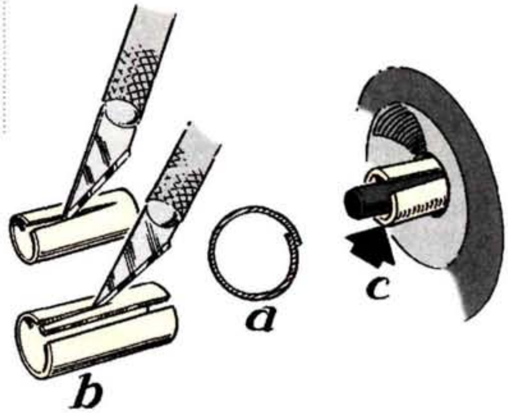
Make a couple of cross slits in an inch or so (25mm) of fuel line (a), screw it to the top of the fin or bottom of the fuselage, then thread the antenna wire (b) through it as shown. It will keep the wire tight yet will allow it to slip if it is snagged.

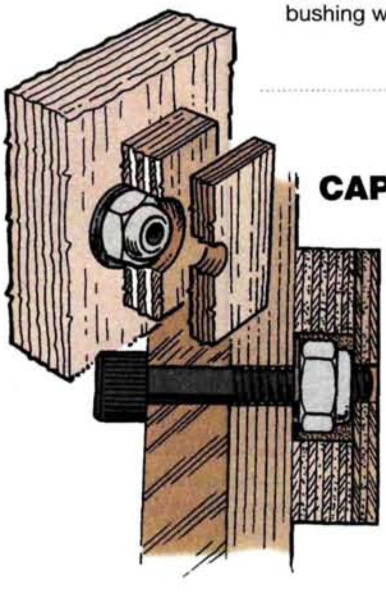
Bryan Wilson, Tulsa, OK

STRAW BOSS

If the holes in your wheels are too large for the gear, use plastic drinking straws or coffee stirrers as temporary bushings. Some slit the straw as shown, then wrap it around the wire as in (a), but a better fit is made by cutting out a strip (b), then butting the edges as you push it into the wheel (c). This plastic bushing will last a surprisingly long time.

Bobby Sanders, San Diego, CA

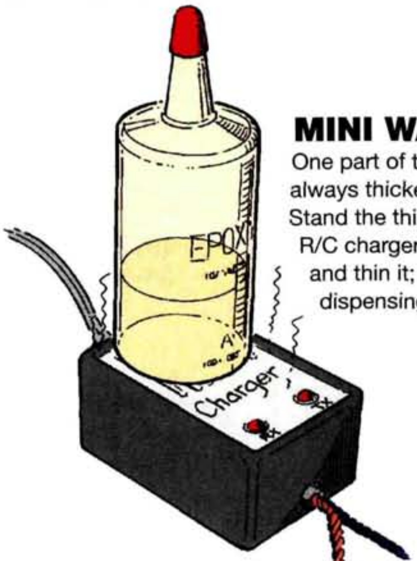




CAPTIVE NUTS

Our contributor uses self-locking nuts on the firewall rear, especially with big 4-strokers. Pull the nuts down tight after mounting, surround them with thick plywood, fill the threads with soap to exclude glue, then bury the nuts in epoxy and cap them with a plywood lid.

Herman Grooters, Hudsonville, MI



MINI WARMER

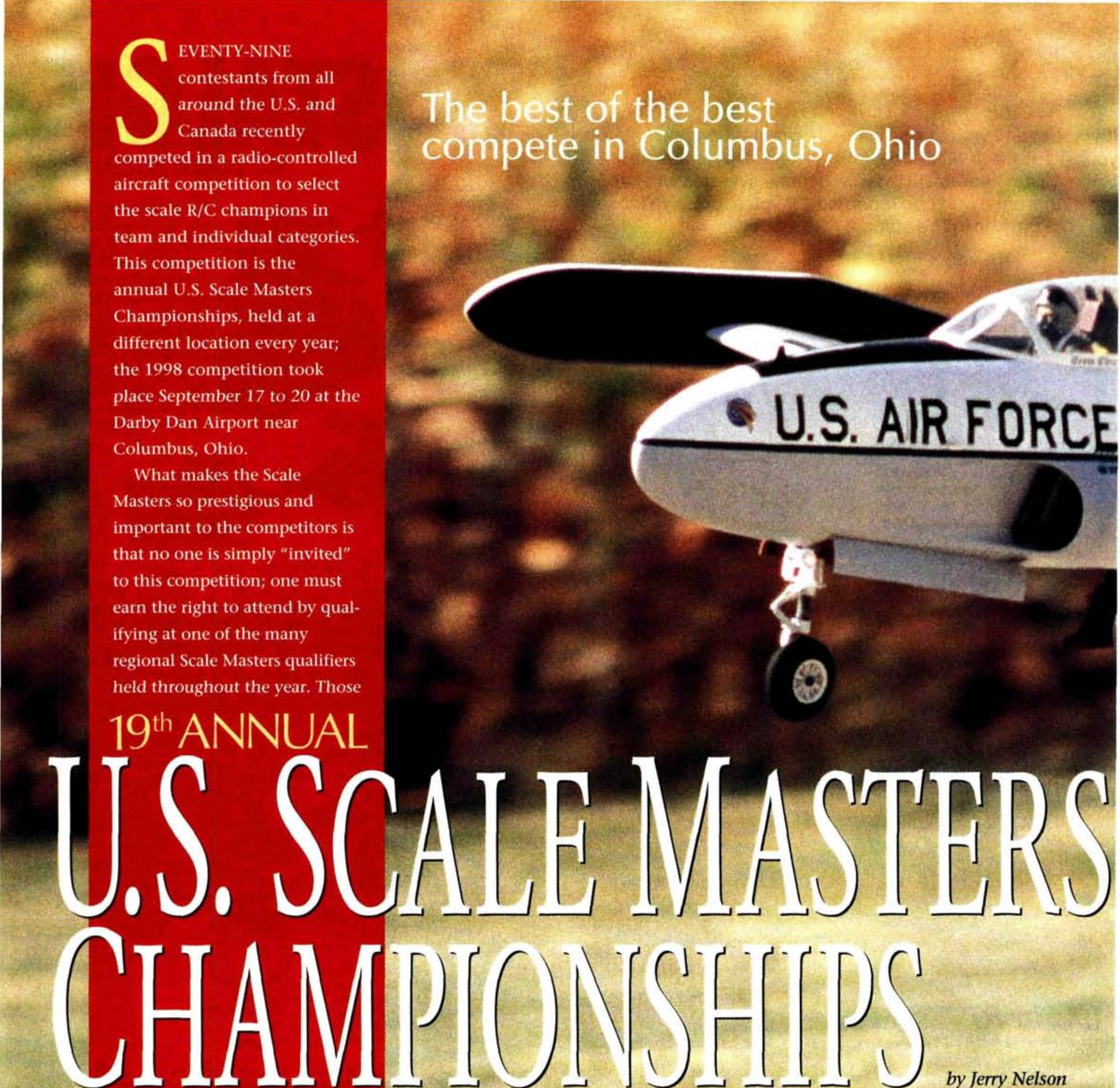
One part of twin-pack epoxy is always thicker than the other. Stand the thicker bottle on an R/C charger for a while to warm and thin it; this will help in dispensing and mixing.

André Landrum, Madison, MS

19th ANNUAL U.S. SCALE MASTERS CHAMPIONSHIPS

The best of the best compete in Columbus, Ohio

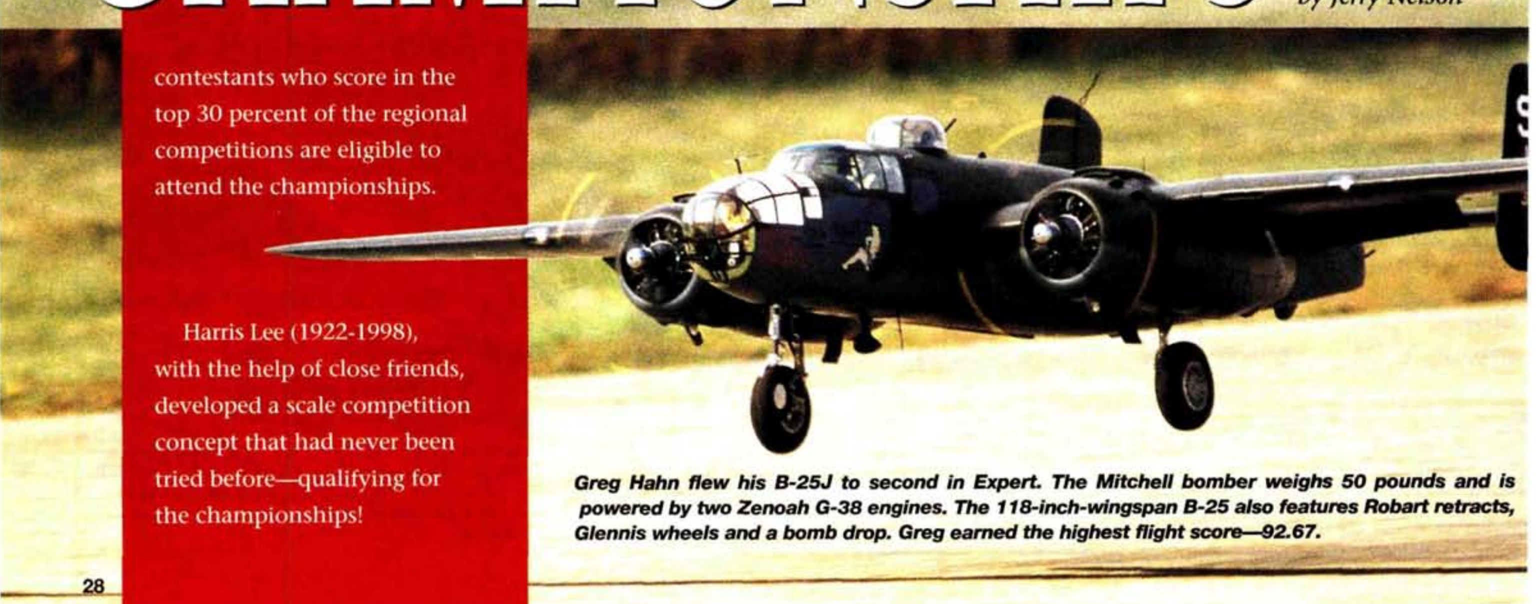
by Jerry Nelson



SEVENTY-NINE contestants from all around the U.S. and Canada recently competed in a radio-controlled aircraft competition to select the scale R/C champions in team and individual categories. This competition is the annual U.S. Scale Masters Championships, held at a different location every year; the 1998 competition took place September 17 to 20 at the Darby Dan Airport near Columbus, Ohio.

What makes the Scale Masters so prestigious and important to the competitors is that no one is simply "invited" to this competition; one must earn the right to attend by qualifying at one of the many regional Scale Masters qualifiers held throughout the year. Those contestants who score in the top 30 percent of the regional competitions are eligible to attend the championships.

Harris Lee (1922-1998), with the help of close friends, developed a scale competition concept that had never been tried before—qualifying for the championships!



Greg Hahn flew his B-25J to second in Expert. The Mitchell bomber weighs 50 pounds and is powered by two Zenoah G-38 engines. The 118-inch-wingspan B-25 also features Robart retracts, Glennis wheels and a bomb drop. Greg earned the highest flight score—92.67.

Main image: Jeff Foley's impressive 1/5-scale T-33 T-Bird (sixth, Expert). Built from a Jet Model Products kit, the 20-pound model includes JMP retracts, operating speed brakes and landing lights. Right: Graeme Mears and Dave Patrick (first, Team) show off their very impressive 31-percent-scale DH 82A Tiger Moth. Weighing 35 pounds, the model is powered by a Moki 3.6 twin and was built from Fredrick Bear plans.

In addition, special rules were created to meet the needs of the scale modelers. The idea was well received, and the 19th annual competition was the result of Harris's continuing dream. He is gone now but the competition is being led by his close friend, Earl Aune. In late 1997, Harris asked Earl and his wife, Josie, to take over the leadership of the U.S. Scale Masters organization.

Earl has done an excellent job in his new leadership role, and the success of the recent championships proves it. The 1998 competition had the most contestants in Scale Master Championship history. Earl obviously didn't run the competition on his own; Bill Midgley was the contest director and Mike Barbee, Terry Nitsch and the local R/C clubs (The Ohio Radio Kontrol Society [TORKS] and Westerville Model Aeronautics Association [WMAA]) ably assisted the contest director. Bill Murray, TORKS president and Bob Bush, WMAA president, did an outstanding job providing the manpower to run the event. Over 80 club members were actively involved with running the competition.

Two events were held: Team and Expert. This was the first time that a Team event was held at a Scale Masters. The Team event allows the builder to have someone else fly the aircraft. The Expert event requires the builder to fly his or her own aircraft. Thus, two championship awards were given out this year.

WHAT'S IT ALL ABOUT?

For those modelers unfamiliar with scale competition, a brief description of the rules is in order. The actual competition consists of two parts: scale (or static) judging, and the judging of how the aircraft flies or performs in the air. One hundred points are awarded for each part, with a maximum possible score of 200 points. The three best flights are added together and averaged for the flight score, which is then added to the static score. The contestants flew five flights, or rounds.

Builder Bill Steffes teamed up with Nick Ziroli Jr. to take fourth in Team Scale. Bill's new AT-6 Texan is 1/4 scale and weighs in at 50 pounds. Bill enlarged the Ziroli Texan plans to build his model and used a Quadra 100 for power. Airtronics radio; Gene Barton retracts; onboard electric starting system; functional lights and smoke system; 92 static score, 84.08 flight score.

HOBBY INDUSTRY SPONSORS

Pacer Technology
Robart
Airtronics
JR Remote Control
R/C Report Magazine
Bob Holman Plans
Magnum Engines
Scale Model Research
Wildcat R/C Fuels
Jet Model Products
Meister Scale
Proctor Enterprises
SKS Video Productions

LOCAL SPONSORS

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Nova Care
Business Solutions
Resurrection Lutheran Church
Barbee Construction
Davis Clock Service

The static judging is composed of 40 points for accuracy of outline, 30 points for color and markings and 30 points for craftsmanship. The contestants must provide 3-view drawings of the full-scale aircraft as well as photos and color documentation.

The flying portion consists of nine maneuvers worth a maximum 10 points each, and an additional 10 points for realism of flight. All competitors have a schedule of two mandatory level-flight-type maneuvers, and a contestant's choice of seven additional maneuvers. The realism-of-flight score is determined by how realistically the model is flown.

An overview of the competition is worth noting for those who have some scale competition experience. Last year's competition in Texas was interesting in that most of the aircraft entered received unusually high static scores (two had perfect 100-point scores). This year's championship scores were more appropriate. Judging is very subjective, and the judges cannot be expected to give perfectly judged scores each and every time. But they can be expected to be pretty close.

The flight scores at this championship were also much more realistic than those of last year. As an observer, I still see certain maneuvers being scored higher than they should be. I believe the problem is that too much emphasis is placed on the actual maneuver, with insufficient concern for the headings and attitudes of the entry and exit portion of the maneuver. Anyway, the judging was satisfactory for this competition. All in all, the judges did a good job. Budget restraints prevent the U.S. Scale Masters organization from developing a full cadre of professional judges who would travel every year to the championships. Perhaps this will occur at some future date; it sure would be nice.

The flying site was good; only problem was, the sun was in our eyes during most of the day—difficult for photographs, too. I guess you can't have everything. The hard surface runway was plenty long for the jets. The grass on the side of the runway could have been better for those fliers who had older aircraft designed for grass runways. At times, the wind blew across the runway, but it wasn't a problem for

Right: Bud Roane (29th, Expert) prepares his 1/4-scale Sopwith triplane for another flight. Below: this 1/6-scale Mirage 2000 took second in Team scale and was entered by Reinol Gonzalez and Alberto Araujo. Powered by a RAM 750 turbine.

Terry Nitsch's 1/6-scale BVM Minuteman F-80 (first, Expert) comes in for a landing. Its operating smoke system worked great. The model weighs in at 20 pounds and is powered by a JPX T-260 turbine; Ditzler paint; ProMark markings over a simulated polished-aluminum finish; 91.83 flight score.

most pilots. Pit areas, transmitter impound areas and the tabulation facilities operated without any noticeable problems.

Two flying areas were employed with two flightlines at each area. A total of four aircraft could operate at any one time. No problems here. Credit must be given to Dave Brown (current AMA president) and his wife, Sally, for their efforts in running the two flying areas. They had to provide traffic control during takeoffs and landings, and they did a great job all three days.

There was an R/C air show each day during the noontime break. They were very well done, and the crowd obviously loved them. More than 2,000 cars were parked on Saturday. Also during the noontime break, all of the aircraft were lined up on the runway with the pilots behind them. The public was then invited to see the models up close and ask the pilots questions. The spectators really enjoyed this part of the show.

The photos tell the story of who was there and who flew what, and the table of results shows how the contestants scored. The Scale Masters always has an excellent collection of high-quality aircraft. There were several turbine jet aircraft in the competition this year, and these aircraft appeared to be very reliable. As you can see, everything from WW I aircraft and twin-engine bombers to modern jets placed in the top 10.

Interestingly, there were no lightweight aircraft in the top 10 Expert aircraft entries. The minimum weight was 20 pounds. Half of the aircraft were jets.

Shades of things to come? Graeme Mears shows off his unfinished WACO UPF-7 biplane; a work of art, it's scale down to the last nut and bolt.

SPECIAL AWARDS

AWARD	WINNER	SPONSOR
Best Documentation	Gary Parker	Scale Model Research
High Static	Tom Cook	Aerotech Models
Best Scratch-built	Ray Torres	Meister Scale Aviation
Best Markings	Bill Killam	Aeroloft Designs
Best Kit	Jeff Foley	Nick Ziroli Plans
Best WW I	Len Ledson	Proctor Enterprises
Best Golden Age	Graeme Mears	Icon N'west
Best Civilian	Charlie Nelson	Great Planes
Best WW II	Greg Hahn	Bob Holman Plans
Best Jet	Alberto Araujo	Bob Violett Models
Best Military	Charlie Chambers	Vailly Aviation
Engineering Achievement	Mike Barbee	Robart Mfg.
Pilots' Choice	Dave Patrick/Graeme Mears	
Highest Flight Score	Greg Hahn	Jet Model Products
Harris Lee Achievement	Roy Vaillancourt	
Most Realistic Mission (Team)	Dave Patrick/Graeme Mears	Airtronics
Most Realistic Mission (Expert)	Greg Hahn	Airtronics
Youngest Pilot	Michael Dinneen (age14)	
Best "Corn" Landing	Bob Underwood	
Last Place Tee Shirt	Frank Tiano	

FIRST TIME AT THE SCALE MASTERS CHAMPIONSHIPS

Michael Dinneen • Len Ledson • Paul Pollock • Russell Strong

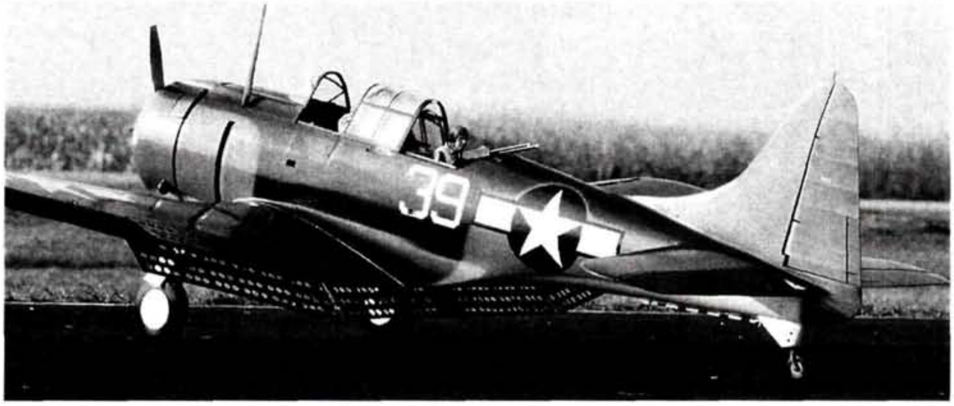
Gary Parker flew this 1/4-scale Proctor Albatros DVA (ninth, Expert). It weighs 22 pounds with an Enya VT-240 4-cycle twin in the nose; Airtronics radio; built after the Stropp Albatros DVA in Smithsonian Air and Space Museum; 84.92 flight score.*

U.S. SCALE MASTERS CHAMPIONSHIPS

There was only one single-engine propeller aircraft; the rest of the propeller aircraft were twins. Five of the top 10 aircraft were built from either the builder's own plans, purchased or modified plans. The remaining five were built from kits.

Note who the sponsors are; it would be next to impossible for this event to happen without their support. The U.S. Scale Masters will be held next year in Fountain Valley (Los Angeles area), CA. Most likely, the championships will be held around the same time in September. I will be there, and I hope you will be, too.

If you are interested in supporting or competing in the U.S. Scale Master Championships program, contact the organization at 21952 Airport Rd., Aurora, OR 97002, or call (503) 678-6036 or (503) 678-4268; email address is jenseninc@msn.com.



***Top right:* Tom Cook entered his 1/6-scale JMP* T-33 T-Bird and placed third in Expert. The model weighs 28 pounds and is powered by an AMT turbine; earned highest static score—96.5. *Right:* Mal Meador's 1:5.6-scale Douglas SBD-5 dive bomber (14th, Expert) awaits another sortie. Built from Jerry Bates plans, power comes from an O.S. BGX-1 3500.**

***Left:* David Ribbe (right; seventh, Expert) prepares to start his 1/6-scale MiG-15. Scratch-built from his own plans, the model is now available as a BVM kit. Power comes from a JPX T-260 turbine; homemade retracts; 93.5 static score, 90.83 flight score.**

U.S. Scale Masters Championships

TEAM CLASS

Place	Name	Model	Static Score	Total
1	Dave Patrick/Graeme Mears	DH-82A Tigermoth	94.5	183.25
2	Reinol Gonzalez/Alberto Araujo	Mirage 2000	91.5	176.583
3	Dave Pinegar/Mariano Alfafara	Clipped Wing Cub	91.5	176.083
4	Nick Ziroli Jr./Bill Steffes	SNJ-5 Texan	92	176.083
5	Jim Sandquist/Wayne Siewert	P-47 Thunderbolt	93.5	174.083
6	Joe Topper/ Dick Heininge	Fokker D-VII	89	172.667
7	Mike Barbee/Michael Dinneen	Piper J-3 Cub	86	168.750
8	John Elliot Jr./Chuck Maitre	WACO YMF-5	84.5	163.250
9	Wayne Frederick/Vernon Altamirano	Cessna 182	86.5	155.667

U.S. Scale Masters Championships

EXPERT CLASS

Place	Name	Model	Static Score	Total	Place	Name	Model	Static Score	Total	Place	Name	Model	Static Score	Total
1	Terry Nitsch	F-80 Minuteman	96	187.833	24	Don Hatch	Yak 18PS	91.5	173.417	47	Mike Winter	Sopwith Pup	90.5	164.500
2	Greg Hahn	B-25J Mitchell	95	187.667	25	Lloyd Roberts	Lockheed Electra	86.5	173.333	48	Gerry Fingler	P-47 Thunderbolt	90.5	164.500
3	Tom Cook	T-33	96.5	186.750	26	Pat McCurry	Me-109G-6	93.5	172.833	49	Alan Senn	Spacewalker	87.5	163.833
4	Ramon Torres	Beech T42-A	96	186.417	27	Len Ledson	Nieuport 17	91	172.667	50	Bill Malinowski	Nieuport 28 C-1	90.5	163.583
5	Charlie Chambers	P-61 Black Widow	96	186.333	28	Tom Polapink	Pfalz D3A	90	172.000	51	Jim Gleason	FW/TA-152	90	162.833
6	Jeff Foley	T-33	94.5	185.417	29	Bud Roane	Sopwith Triplane	88	171.917	52	Stan Clark,	Curtiss A3-B Flacon	82	162.667
7	David Ribbe	MiG 15	93.5	184.333	30	Jim Sandquist	P-47D Thunderbolt	92	171.917	53	Bill McCallie	P-51D Mustang	87	162.583
8	Shailesh Patel	F-4 Phantom	94	181.75	31	Jeff Lovitt	DHC-1 Chipmunk	87	171.250	54	Charles Baker	PT-26 Cornell	88.5	161.583
9	Gary Parker	Albatros DVA	96	180.917	32	Dick Hansen	Curtiss Jenny	90	170.917	55	Jeffery Pike	DHC-3 Otter	84.5	159.417
10	Nick Ziroli Sr.	P-38 Lightning	92.5	179.833	33	Bob Benson	Beech T-34C	90.5	170.083	56	Corvin Miller	F4U Corsair	92.5	147.833
11	Wayne Frederick	Fokker D-VIII	95.5	179.250	34	Bill Hinnant	Laser 200	87.5	169.75	57	Hal Parenti	Ryan Fireball	94.5	146.167
12	Charles Nelson	WACO VKS-7F	94	178.583	35	George Jenkins	A4D Skyraider	86.5	169.667	58	Norman Malinowski	Albatros DVA	92.5	138.583
13	Brian O'Meara	F4U Corsair	92.5	178.333	36	Bill Killam	Fokker D-VII	90.5	169.667	59	Russell Strong	Nieuport 11	92	128.583
14	Mal Meador	Douglas SBD-5	93.5	178.333	37	John Wood	Spacewalker	88.5	169.417	60	Dan Pierson	Lockheed Little Dipper	86.5	124.500
15	Kim Foster	Nieuport 28	92	178.167	38	Bob Patton	T-34A	90	169.417					
16	Dave Lovitt	Lockheed HC-130H	90	178.667	39	David Hayes	P-51 Mustang	95	168.500	61	Paul Pollock	Fairchild PT-19	82.5	120.167
17	Gary Russell	Spitfire Mk XIVC	93.5	177.000	40	Lee Rice	F4U Corsair	93	167.000	62	Al Kretz	Dornier DO-23G	89.5	116.167
18	Steve Sauger	Aeronca Sedan	94	175.333	41	Bob Benjamin	Taylorcraft BC-12	86	166.000	63	Mike Barbee	Boeing B-29	92.5	113.083
19	Jean Chevalier	Ryan STM-E2	90	175.167	42	David Anderson	Howard Pete	87	166.000	64	Roy Vaillancourt	Stinson L-5	88.5	97.500
20	Bob Underwood	IL2M3 Stormovick	93.5	174.833	43	Manny Sousa	Grumman XF5F-1	87.5	165.583	65	Doug Crumley	Bellanca Decathlon	92.5	92.5
21	Joe Topper	Nieuport 28 C-1	91	174.750	44	Dave Sawatzky	Beech T-34A	90.5	165.417	66	Bob Karlsson	Grumman Wildcat	87	87
22	Skip Mast	Piper J-3 Cub	93	174.417	45	Randy Smithisler	Piper PA-12	83.5	164.917	67	Gary Fuller	P2V-1 Neptune	85	85
23	Chris Spangenberg	Me-109G-6	92.5	173.833	46	Jim Wilkinson	FW 190-A8	90.5	164.667	68	Frank Tiano	PT-19	82	82

MODEL AIRPLANE NEWS
FIELD & BENCH
REVIEW

$^1/_5$-scale Foam and Fiberglass Fighter

by Whitney Philbrick

The FW190D9 was a hasty improvisation derived from another, unwanted, plane that almost never flew; it became Germany's best piston-engine fighter of WW II. Kurt Tank, the FW190's designer, and Focke-Wulf were allowed to continue its development only because its design called for a radial engine and wouldn't compete for the in-line Daimler-Benz that was in such short supply for the Me 109. The short-nose FW190As turned out to be outstanding fighters and fighter-bombers, and Kurt Tank turned his design genius to his next project, the TA 152. With time running out, Kurt used another in-line engine, a Junkers Jumo, and re-engined the FW190. A short, aft, fuse extension panel was inserted to lengthen the tail and compensate for the longer nose, and the FW190D was born.

INNOVATIVE MODEL PRODUCTS FW190D9

The Innovative Model Products* (IMP) 1/5-scale FW190D kit comes in two large cardboard boxes—one containing the fuselage, the other, the wing cores, wooden parts, hardware and scale accessories. For ease of identification, the wooden parts all have part descriptions written on them. The scale accessories are plastic, fiberglass, polyester resin and clear acetate. Full-size construction drawings are provided, but since the fuselage is fiberglass and the wings are sheeted foam, plans for a built-up version are available as an option; I recommend them.

SPECIFICATIONS

Model: FW190D9

Type: scale WW II warbird

Manufacturer: Innovative Model Products

Wingspan: 83 in.

Length: 80 in.

Weight: 20 lb.

Engine rec'd: 1.5 2-cycle, 2.4 4-cycle

Engine used: Moki 1.8 2-cycle

Radio req'd: 6-channel (elevator, ailerons, rudder, throttle, flaps, retracts)

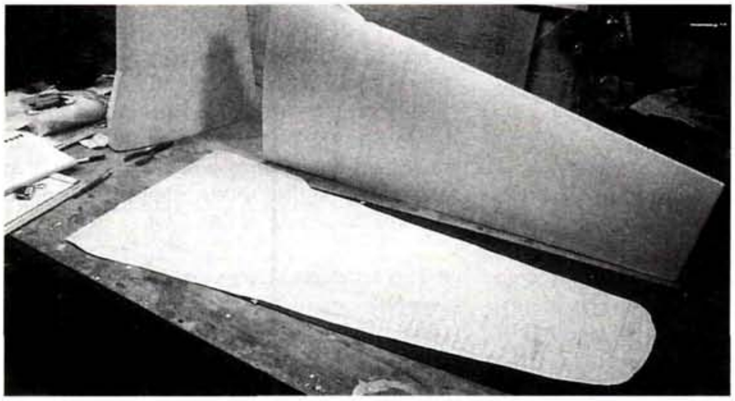
Radio used: Airtronics 660 Infinity with 92765 receiver, 10 servos

Prices: $459 (Basic Kit), $1,099 (Deluxe Kit)

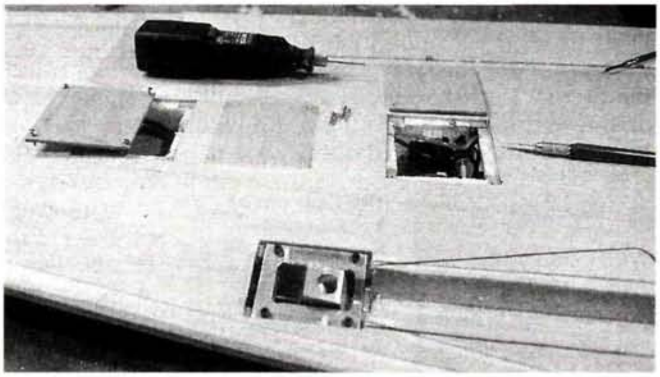
Features: fiberglass fuselage and cowl; sheeted foam-core wings.

Hits
- Extensive builders' guide.
- Lightweight construction.
- Innovative carbon-fiber spar construction.
- Numerous scale accessories included.
- Excellent support from Greg Namey at IMP.
- PFM adhesive.

Misses
- Errors and omissions in plans and instructions (too sparse in spots, especially flap/aileron construction).
- Parts missing or cut incorrectly (wooden and foam parts missing: firewall, formers and wing-cores cut too small).
- Difficulties in properly adjusting the main landing gear.



Left: the wing templates are cut from the plan and glued to construction paper; foam-cores are in the rear. Start by placing the templates carefully on the bottom sides of the foam-cores.



Right: hatches for servo access, retract-gear installation and scale gear door outlines have been drawn on balsa. A small hand-held Dremel tool with a drill bit makes it easy to drill precisely. Use the See-Temp template to exactly position the four mounting screws that go into concealed hardwood blocks glued into the foam-cores.

This kit will yield a topnotch scale model for the experienced scale builder; some minor defects may hamper the average builder. First-time foam and glass builders will profit considerably from the builders' guide included in the kit.

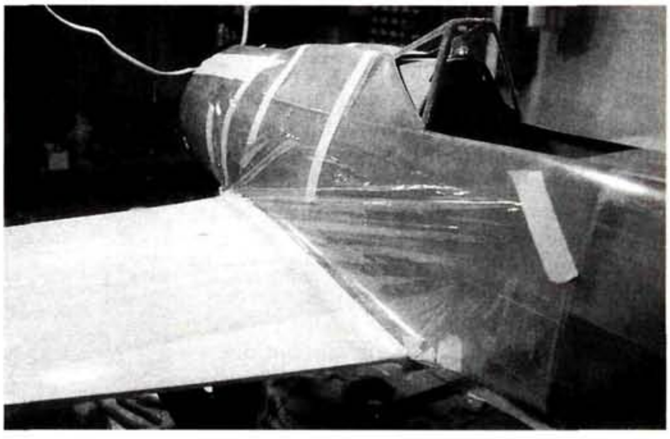
The first steps in constructing this FW190 are to read and then reread the large builders' guide and the smaller, supplemental, kit-specific instructions. The builders' guide is a real plus; it contains step-by-step descriptions of the techniques used to construct most foam and fiberglass kits; I recommend it in its own right. The supplemental instructions are brief, but the builders' guide is there as a backup. The experienced builder probably won't need more instructions anyway, and this is not a beginners' kit!

BUILDING

• **Wings.** Start by making the wing template from the plans per the builders' guide; 3M 77 and art-store cardboard are all that are required. This template is taped to the bottom of the foam-cores and used to guide the cutting out of the servo pockets, retract and wheel-well areas, servo-wire routing corridors and spar channels. Spar channels will also be constructed on top of the wing. The template makes finding their correct locations easy, and the builders' guide tells how to turn a soldering gun into a hot-wire cutter and includes templates for the cutting shapes required. Just take your time and follow the guide; it's easier than you think! I didn't cut the spar channels from my template; I just measured the drawing and taped small balsa strips to serve as guides, but the rest I did "by the book!"

Once all of the foam cutting has been done, the next step is to mount the retracts. Here, I added carbon-fiber reinforced-plywood boxes to surround IMP's retracts and to support the retract mounting rails. I fly off grass fields and wanted some extra strength there. I used a hot-wire cutter to extend and deepen the retract-area cutout and then fitted the boxes in carefully, using the struts and a weighted line to ensure the proper forward rake of the gear directly under the wing's leading edge.

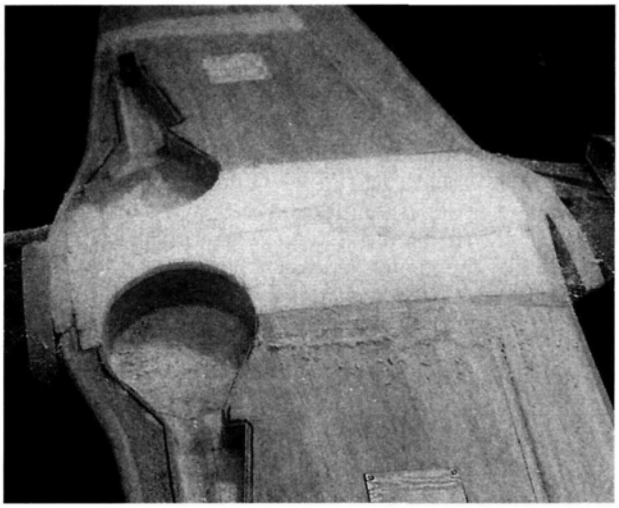
I cut the spar channels next. I liked this technique; I believe it easily builds a nearly full-length, strong but light reinforcement to the traditional foam and balsa wing. Channels no more than 1/8 inch deep are cut into the foam according to the plans; carbon-fiber tow is laid into each channel and covered with 30-minute epoxy that has been heated to allow it to flow more easily. Using a surgical-gloved finger, I spread out the tow strands along the width of the channel and then let the epoxy harden. Fill any gaps between the



An epoxy and micro-balloon fillet is built up on the top surface of the wing to further fair the wing to the fuselage. The fuse comes with a fillet already molded in, so this step isn't totally needed, but if you're willing to take the time, it does ensure a scale fuse-to-wing joint. Ordinary plastic food wrap is used as a barrier; later, the fillet is sanded and auto-body filler is used to smooth any rough spots.

spar surface and the wing surface (not yet sheeted) with more epoxy and microballoons.

Then I sheeted the wing; I used 3M 77 with good results. Attach the leading and trailing edges according to the instructions and sand away! Unfortunately, my foam-cores had been cut $\frac{1}{2}$ inch too short along the length of the leading edge, and one core was $\frac{3}{8}$ inch too large spanwise. I called Greg Namey at IMP, and he came up with an easy solution that soon put me back in business. Future kits will have this problem solved.



A belly pan is built up using scrap foam then covered with light balsa and glassed.

I took advantage of the temporary sheeting over the wheel wells to lay up several layers of fiberglass cloth, carbon fiber and resin over the retract strut and wheel-cover location (using clear MonoKote* as a release agent). I soon had scale gear doors exactly matching the curvature of the wing! Only then did I cut away the extra sheeting over the wheel wells. Greg at IMP suggested this procedure, and it worked like a charm.

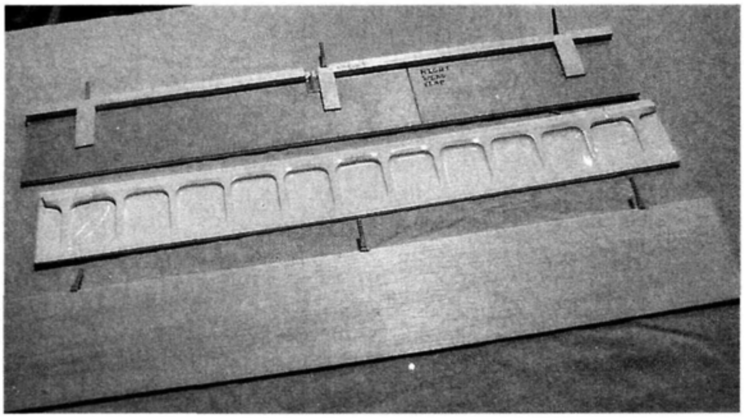
Before gluing on the balsa wingtips, block up the tips $4\frac{1}{2}$ inches, and sand the dihedral angle into the wing roots. The only difficulty may come with the carbon-fiber spars; use a Dremel* cut-off tool to speed up the work here.

I made a tracing-paper template of the plans to exactly mark the locations of the flaps and ailerons, then I cut away the split flap area first and boxed it in with balsa trailing-edge material and scrap plywood half ribs. More information in the supplemental kit booklet would have helped here. The last step is to join and then fiberglass the wings. I used Aerospace Composite's* fiberglass cloth and EZ Lam resin: 4-ounce cloth over the wing's center half (top and bottom), and 1-ounce cloth to cover the entire wing (top and bottom) after the center glassing had cured. Small strips of carbon-fiber tow increase the strength of the center wing joint. Overall, IMP's process builds a strong wing!

• **Fuselage.** The molded fiberglass fuselage has two plywood wing hold-down plates, two balsa bulkheads and a plywood firewall, all of which must be glued into place. Several of these parts were slightly too small and left noticeable gaps that PFM* handled with no problems. Mount the wing on the fuselage before you install the firewall so that you'll be able to drill directly through the front hold-down plate and into the wing leading edge to ensure the correct placement of the hold-down dowels.

I used PFM for all of these mounting steps, though I gave the firewall and the mounting blocks resin and cloth reinforcement. I centered and mounted the Moki* engine on the firewall with 10-32 bolts and blind nuts, then I glued the firewall into place. After mounting the wing on the fuselage, build up an extension of the fuselage fillet on the top wing surface using epoxy and microballoons. I used plastic food wrap as a release agent and finished the fillet with automotive body filler.

To hide the cowl-mounting screws, I cut two thin rings of plywood, each supporting a tab at 9, 12, and 3 o'clock. The smaller ring fits just inside the front of the fuselage. The larger ring fits inside the cowl at the far back. The tabs match up, and with blind nuts in the tabs on the fuselage circle, it is easy to get at the mounting bolts through the front opening of the cowl.



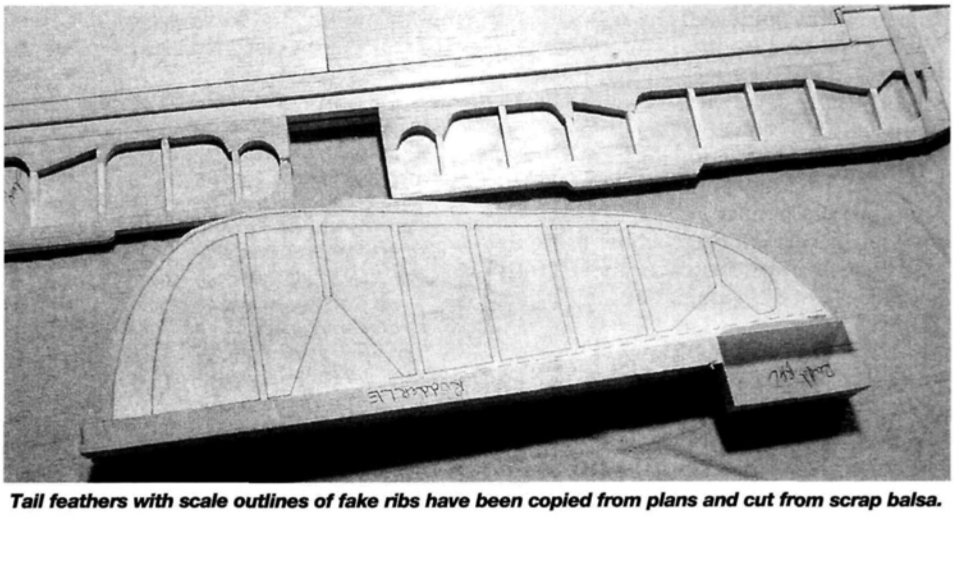
The flaps are of built-up balsa and lite-ply construction that's glassed on the underside (wing surface) and has a nice, scale, vacuum-formed plastic, inner-surface detail piece glued on with PFM. The Basic Kit's many scale detail parts are a plus.

• **Tail feathers.** These are constructed like mini wings. Sheet them with $\frac{3}{32}$-inch balsa, then glue on the balsa leading and trailing edges, sand to shape and glass. IMP includes carbon-fiber tow to reinforce the center joint—a nice touch!

The movable parts are built up from $\frac{3}{32}$-inch balsa cores using balsa half ribs and precut tips and balances; sand to shape and cover with cloth like the real thing. I used Stits cloth from F&M Enterprises* with great results.

To install the surfaces in the tail, I had to cut holes in the fiberglass fuse. The vertical fin's location is obvious, and there's a line in the fiberglass for the centerline of the horizontal stabilizer; this gives a deliberate and necessary 2-degree positive incidence. Use this line and a tracing from the plans to carefully mark the stab outline, and make the cutout with a Dremel tool and a cut-off wheel. I cut a little undersize and sanded it to the final shape, test-fitting as I went.

With the wing in place as a reference, I tack-glued the horizontal stab into place then used resin and cloth on the inside to



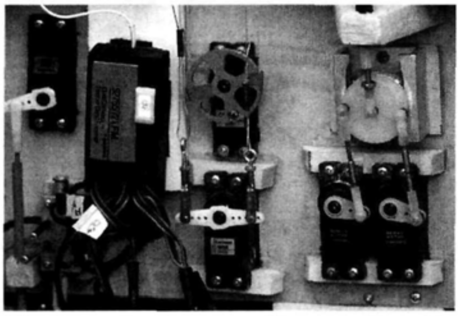
Tail feathers with scale outlines of fake ribs have been copied from plans and cut from scrap balsa.

complete the attachment. The fin was not done until later, as I needed to maintain access to the tail-wheel-retract location and the internal elevator linkage.

• **Tail retract**. I made a balsa-and-plywood mount to support both the retract assembly and the air cylinder that allowed me to adjust the movement to the correct degree of throw and correct relationship before installing in the fuselage. With the retract installed, getting to the cylinder is difficult!

With the tail retract in place, I installed and tested the Sullivan* giant-scale pushrod linkage to the elevator, routed the pull-pull cables to the tailwheel steering and rudder and glued the fin into place with epoxy. I filled in the vertical fin-to-fuselage joint with epoxy, microballoons and auto-body filler.

• **Radio installation**. The forward fuselage has plenty of room for the onboard gear. Servos, fuel tank, retract air tank, retract control valve, onboard glow unit and three sets of batteries all found room up front. I used an Airtronics* 660 Infinity Radio with both giant-scale and helicopter servos. I joined two 94735s with a C.B. Associates* doubler to drive the elevator, while each flap and aileron got its own 94735. The rudder is driven by one 94161. I used a 6-channel Airtronics 92765 FM receiver with a battery-backup system made of two 5-cell 1000mAh batteries, each with its own switch harness and Jaccio* regulator.

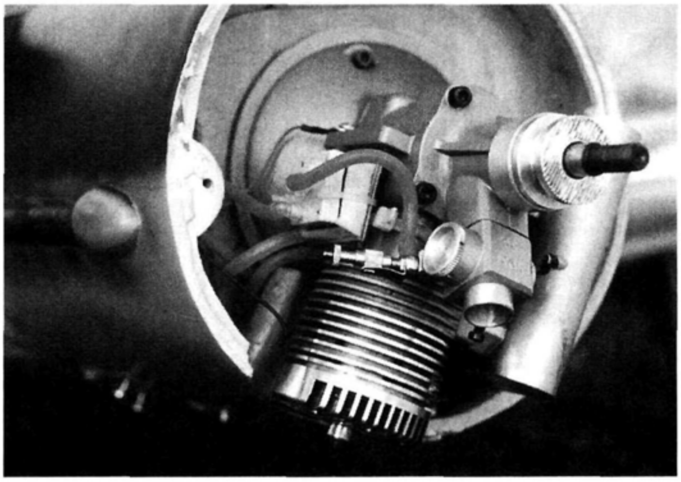


The large fuselage provides considerable latitude for setting up your radio gear to suit personal tastes. Doubling up servo control is a good idea with this plane.

SCALE DETAILING AND PAINTING

The fuselage comes with panel lines and other details molded in and a separate fiberglass gun hood. I added panels and other details made out of aluminum plumbing tape and guns and a Pitot tube out of brass tube, and the rivets are glue drops. I made the panel lines on the wings with 1/64-inch draftsman's tape that was applied after the first coat of Stits FC-900 Feathercoat primer, then two more primer coats sanded flat, and then was peeled off to leave indented lines like those on the fuse. Wing "rivets" were made with a sharpened brass tube chucked up in a cordless Dremel tool. I found the new Great Planes* scale rivet template of great help in positioning the rivets. The cockpit is a conglomeration of IMP and J.D. Scale Models parts with an IMP pilot.

After glassing and adding major details, I primed the plane with FC-900 from F&M Enterprises, sanding between coats. This is a one-part primer specifically made to build up a sandable base for painting with the Stits line of Poly-Tone paints. It has excellent adhesion to a range of surfaces, including metal and fiberglass. I sprayed a light coat of FC-900 onto all metal parts to give the Poly-Tone color a good foothold. The color coats were sprayed on using an automotive touch-up gun and a Paasche* airbrush. The premixed Poly-Tone went through my airbrush without further thinning. I was very pleased with this paint and with the support available from Chip Mull at F&M. I added some flattener to dull the otherwise glossy or semigloss Poly-Tone paints.



The Moki 1.8 is more than enough power to fly this bird and it nestles into the nose real well.

CONCLUSION

I was pleased with the results, but feel some minor defects should be corrected; IMP promises that future kits won't have these problems. One pleasant part of this kit was the excellent support Greg Namey provided, both over the phone and in person at various meets and shows.

**Addresses are listed alphabetically in the Index of Manufacturers on page 134.*

FLIGHT PERFORMANCE

by Dean DiGiorgio

The first time we flew the IMP FW 190D9, it was typical of most warbird first-flight sessions. There were a few minor bugs to work out, and we tried to keep them to a minimum. First, we made sure the model balanced according to the plans, and then we ran up the Moki 1.8 and set the mixture. We double-checked control surfaces and cycled the main landing gear; everything checked out OK.

• TAKEOFF AND LANDING

We did not taxi the model to the takeoff position because the tail-wheel retract mechanism was not working, and we wanted to keep stress off the strut. Whit's dad, John, wheeled the model to the far end of the runway and held the tail for one last engine run-up.

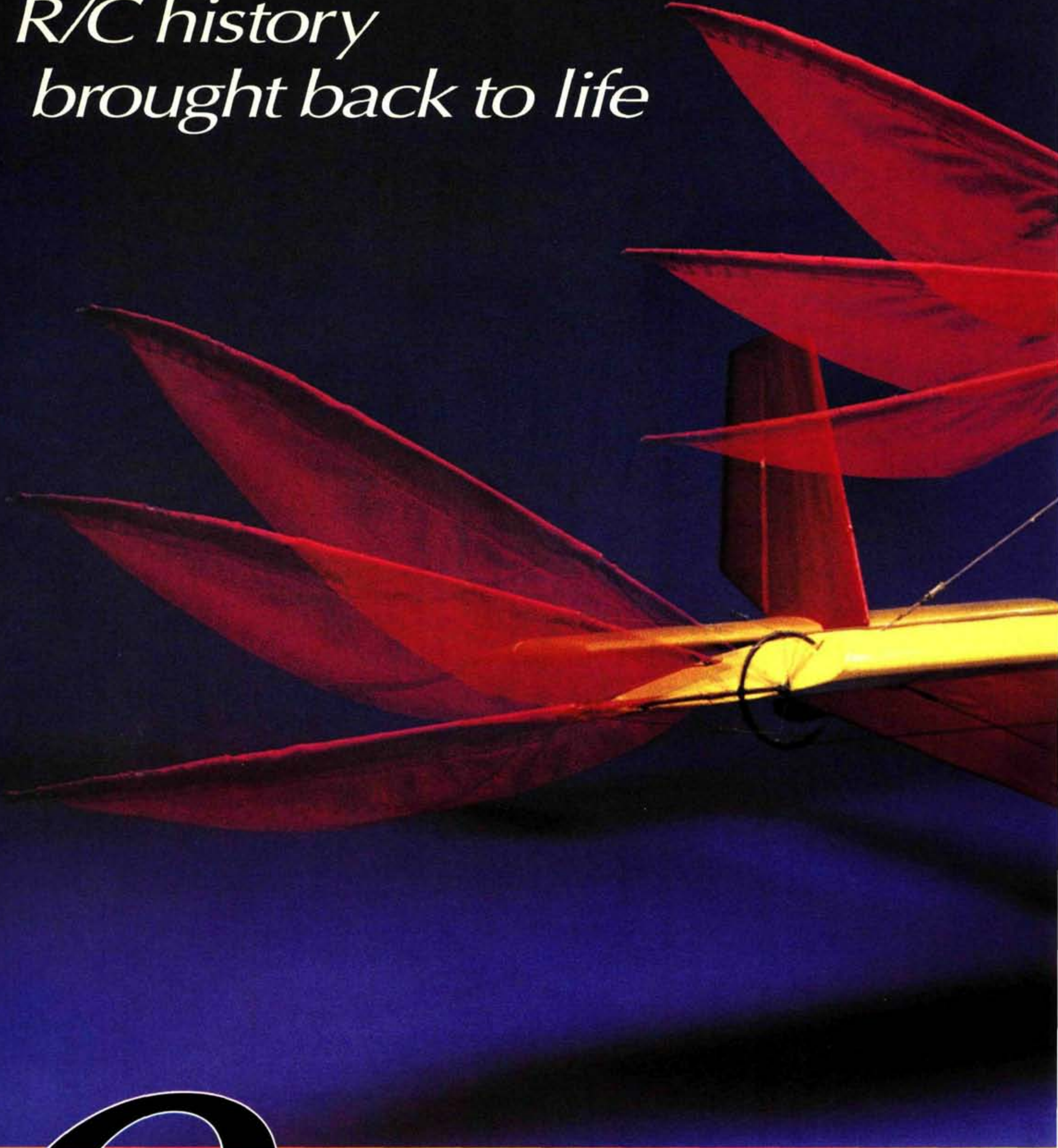
I applied throttle slowly and steadily, and the 190 tracked nice and straight with very little demand on the rudder. The model left the ground in a tail-low attitude and was very sensitive to pitch (tail-heavy). The model has more than enough power with a Moki 1.8, so I lowered the nose a bit and flew the 190 high to feel out the controls.

When I set the model up for landing, I lowered the flaps and found that there was very little need to retrim. The model came in nicely, and I held a little power in until I flared it for touchdown. Once it was down, we added 4 or 5 ounces of lead to the nose, and the second test flight felt much better. We also changed from an 18x6 prop to an 18x10, and this provided much better performance.

• GENERAL FLIGHT PERFORMANCE

Properly balanced and spinning the 18x10 prop, the IMP FW190D is a stable, smooth flying warbird. Flight controls provide good response, and when slowed down, the model shows equally good flight characteristics.

R/C history brought back to life



SPENCER'S Ornithopter

by Faye Stilley

SOME MEN BUILD an aircraft, get in and go flying. That's the kind of man Percival H. Spencer was. Born in 1897—before men were flying—he made his dream come true in 1911 when he built and flew a biplane hang glider. Three years later, while still in high school, he rebuilt a wrecked version of a Curtiss flying boat and taught himself to fly. That was the beginning of a long career of designing, building and flying aircraft. Spencer is best known for the Spencer-Larsen amphibian, the Seabee and the Spencer Aircar amphibian.

Spencer wanted to build a man-carrying ornithopter. In the early 1930s, he built and flew

several rubber-band-powered models and, in 1934, he patented one. That same year, he built a gasoline-powered biplane ornithopter that, unfortunately, did not have enough power to fly. In 1956, he patented an improved version of the rubber-powered ornithopter called "Wam-O-Bird" and sold thousands. In the late '50s, he built a series of Seagulls powered by model airplane engines. They flew free-flight, but were tethered. Wanting to unleash his Seagulls, Spencer approached Jack Stephenson, an avid R/C flyer, and asked, "Can the Seagulls be converted to R/C control?" Jack decided that the relays in his R/C models could not withstand the bouncing caused by the flapping wings, and he suggested a biplane version with opposing flappers to cancel out the bouncing motion. Spencer agreed immediately. After all, he had built a biplane ornithopter back in 1934. Spencer and Stephenson collaborated for several months, and in June 1961, the R/C prototype model was completed and flying. Unfortunately, Spencer died before he could complete the development of the man-carrying version.

SPECIFICATIONS

Wingspan: 90.7 in.

Length: 52 in.

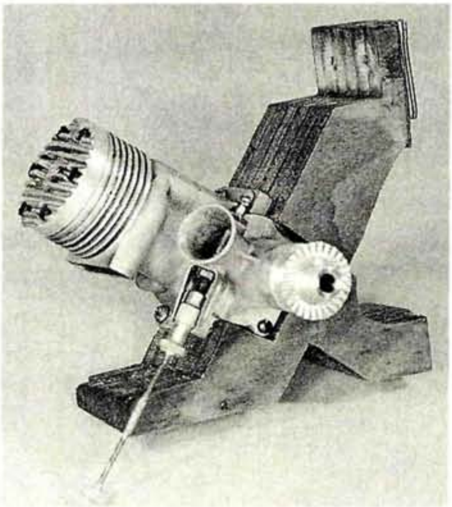
Weight: 7.5 lb.

Power: .35 2-stroke

Construction: balsa and ply

Covering: silk and dope

Percival Spencer holds the 70-inch-span, free-flight prototype of the ornithopter.



One "leg" of the mount is bolted to the side of the fuselage and the other to the bottom. The engine is a Torpedo 35.

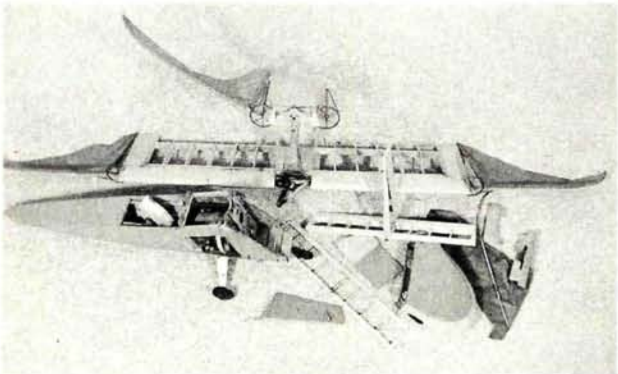
RESTORATION PROJECT

Jack Stephenson believes that the Spencer Orniplane model was the first successful R/C ornithopter and the only one ever to take off from the ground. Thirty-five years later, I was asked to restore the model to display in the New England Air Museum. I agreed because I thought it would be a lot of fun and educational, too.

The surviving parts were covered with decades of dust, soaked in oil and came replete with several generations of spider webs and carcasses. I admit that I had second thoughts about what I had agreed to do, but they quickly disappeared when I began to examine the pile more closely. I was fascinated with the ingenuity that went into this unusual bird. There were no hobby shop "goodies" here. Virtually every part—wood and metal—was handmade. My mission was to restore it to original. It would be much easier to build one today because of all the available parts, accessories and materials; I hope that some clever modelers will take the challenge and build 1999 versions.

THE ENGINE

Spencer's design called for the engine to be installed within the fuselage. It needed to be cooled by air and also be accessible for starting and adjustment. Most important, it had to line up perfectly with a gearbox that would transfer power to the flappers. He came up with something that looks more like some sort of modern art than it does an engine mount. As odd as it looks, it met all the requirements. One "leg" was bolted to the side of the fuselage and the other to the bottom. The engine is a Torpedo 35.



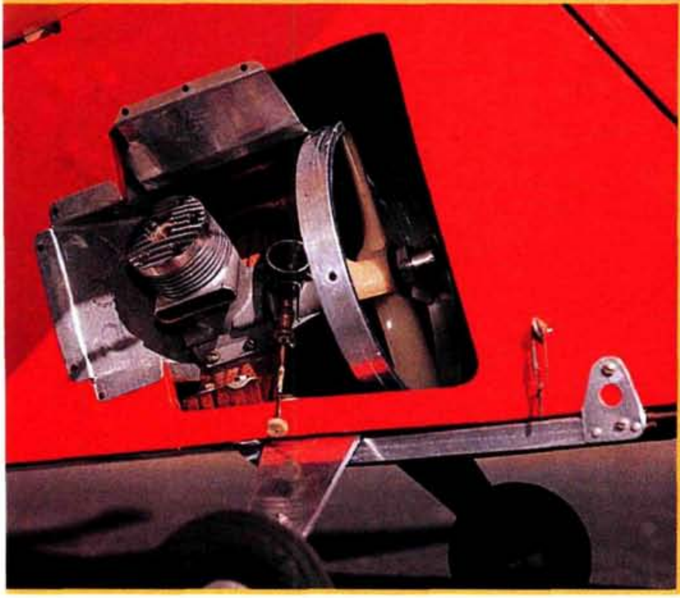
Left: this is what was left of the prototype model when it arrived at my door.

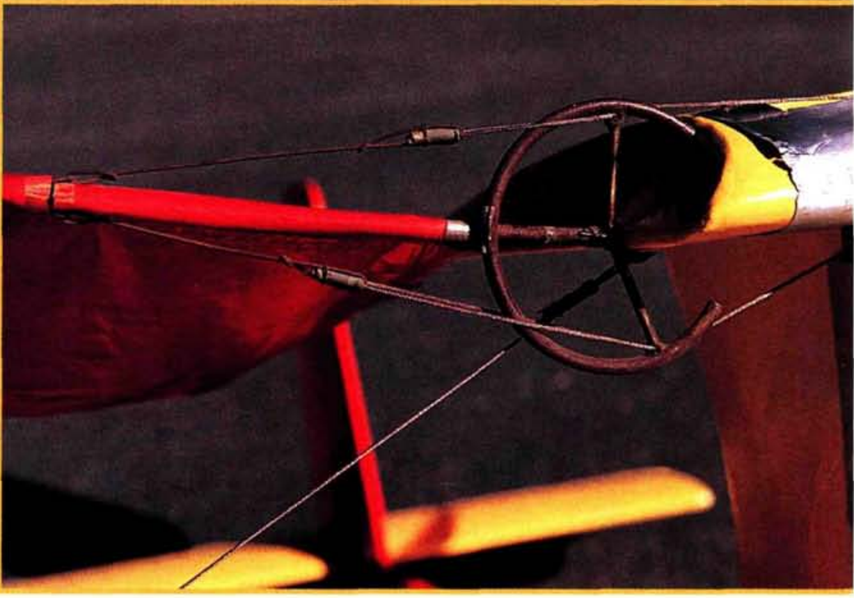
For engine installation, two 12x4 nylon propellers were cut down and fitted together to form a fan. An aluminum ring was attached around them to complete the fan/flywheel. Lightening holes drilled in the ring helped to balance the assembly. The flywheel protrudes outside the fuselage to facilitate hand-starting, and the cylinder head and needle valve are accessible from outside the fuselage. A shroud encircles the engine to force air over it, and a baffle behind the engine directs the air back out of the engine compartment. An inlet hole above the gearbox allows air in through the forward bulkhead.

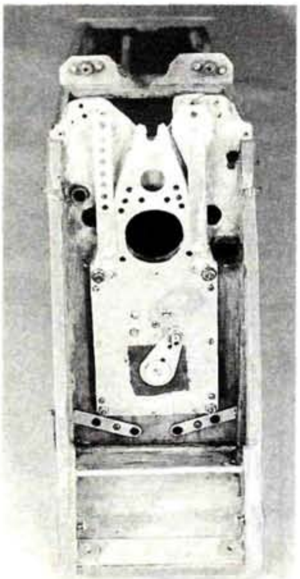
SETTING THE GEARS AND PULLEYS

After experimenting with several gear ratios, I chose to use 30.5:1. With the engine running at about 12,000rpm, the flappers cycle about 6½ times a second. I used a simple, two-stage gear setup with an 8-tooth pinion driving a 56-tooth gear for the first stage and an 11-tooth pinion driving a 49-tooth output gear for the second stage. I drilled and riveted slabs of nylon material to the gearbox covers to serve as gear shaft bushings.

The upper tower section shown in the photos contains the main drive pulley and idler pulleys, which guide the drive cables to the flappers. The large pulley attached to the lower center of the tower is the main drive pulley. It drives the lower wing flappers with cables connected directly to it. It also drives the upper wing



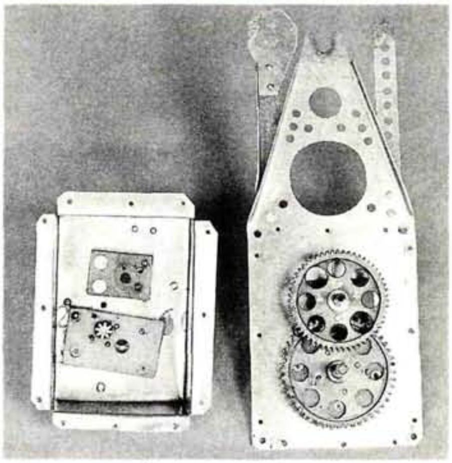




The output side of the gearbox and the lower end of the tower section, which is permanently attached to the wing assembly. The output arm (crankshaft) is connected to the main drive pulley on the upper tower section with a long conrod. The large round hole above the crankshaft is an air duct to the engine compartment.

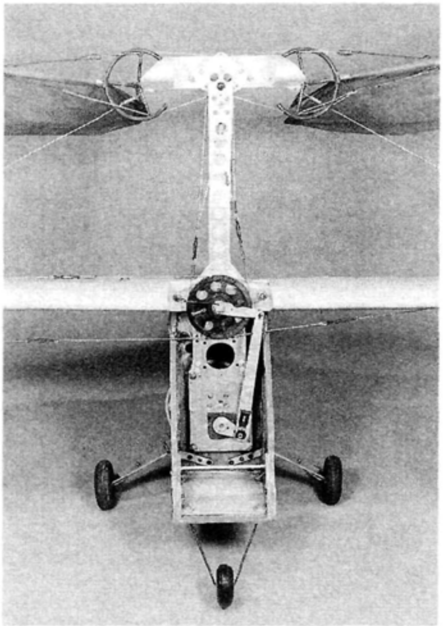
flappers with cables routed to them over idler pulleys in the upper section of the tower.

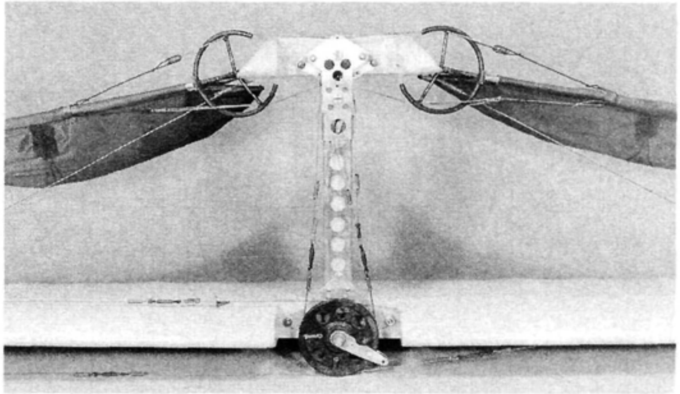
The large, spoked pulleys are attached to the upper wing flappers. Spencer made the flapper pulleys from tubing, which was slotted to form a pulley-type rim. The flapper pulleys on the lower wing are the same as those on the upper wing. The cables from the flapper pulleys connect directly to the main drive pulley. They travel straight to the drive pulley on one side and cross on the other side. This cable arrangement pulls the left and right flappers up or down in unison.

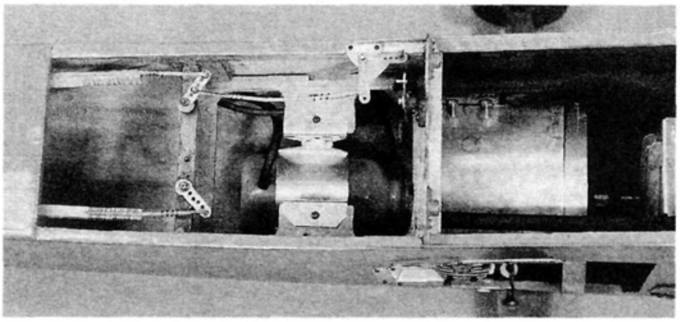


The open gearbox.

When the power train is assembled, the crankshaft arm rotates and pumps the conrod—and in turn, the main drive pulley—up and down, much like a piston. The oscillating motion of the main drive pulley on the drive cables controls the direction and distance of the flappers' travel. If you have read this far, I'd guess that you have come up with some other creative way to transfer power from the engine out to the flappers. Figure 1 illustrates how Spencer hooked up the cables.


The complete power train with the conrod in place.


The upper tower section contains the main drive pulley and idler pulleys, which guide the drive cables to the flappers.

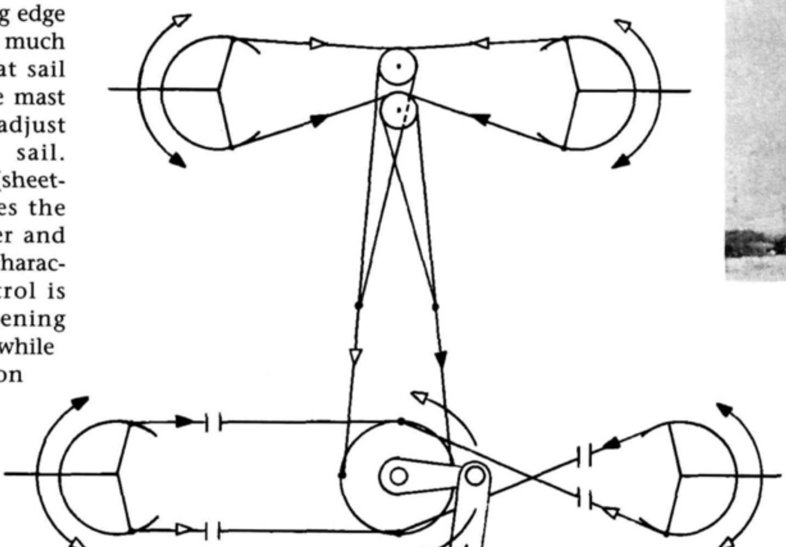

The aileron control cable is linked to the rudder pushrod idler arm to provide coupling. An idler arm is used to adjust rudder throw. The nylon bellcrank is the only prefabricated part, besides the wheels, on the entire aircraft. It is linked to a second idler arm, which in turn is connected to the aileron control cable and the rudder servo. The fuel tank is suspended by aluminum brackets.

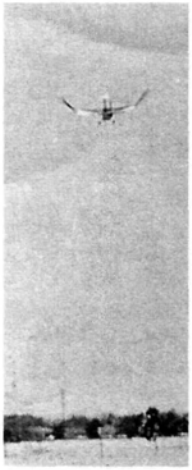
THE FLAPPERS

The flappers are made of rip-stop nylon. In some ways similar to the wings of a bird, they create lift and thrust by flapping. The amount of curvature in the fabric across the span determines the amount of lift and thrust generated. The darts in the flapper limit the maximum curvature. There are many other factors involved in the effectiveness of a sail (flapper); however, this very simple design proved itself effective enough to propel the Orniplane. Adjusting the tension of a sail changes its performance. There were no provisions made to adjust flapper tension in flight except for "aileron" control.

The root rib (metal rod) on the main wing flappers is hinged at the connection to the leading edge (aluminum tube). It acts much like the boom of a boat sail that is connected to the mast and can be moved to adjust the tension of the sail. Tightening the flapper (sheeting in the sail) changes the curvature of the flapper and therefore its lift/thrust characteristics. Aileron control is accomplished by tightening the flapper on one side while loosening the flapper on the other side. The movable root rib is connected to a cable that runs through the wing to the other root rib. The oblong metal loop limits the travel of the root rib and therefore, the maximum curvature of the flapper.

The complete wing assembly with the main drive pulley and all the cabling installed is connected to the fuselage by four wing bolts and to the output crankshaft by the conrod. After the aileron cable and two guy wires have been connected, it is ready to fly.


The cables to the upper flappers travel over two pairs of idler pulleys. The upper pair controls the pull motion for the flapper upstroke, the bottom pair the pull motion for the downstroke. The lower pair of pulleys have a spacer between them to allow clear travel for the cable traveling to the upper idler pulley. The arrows show the direction of travel during the open and close power strokes.



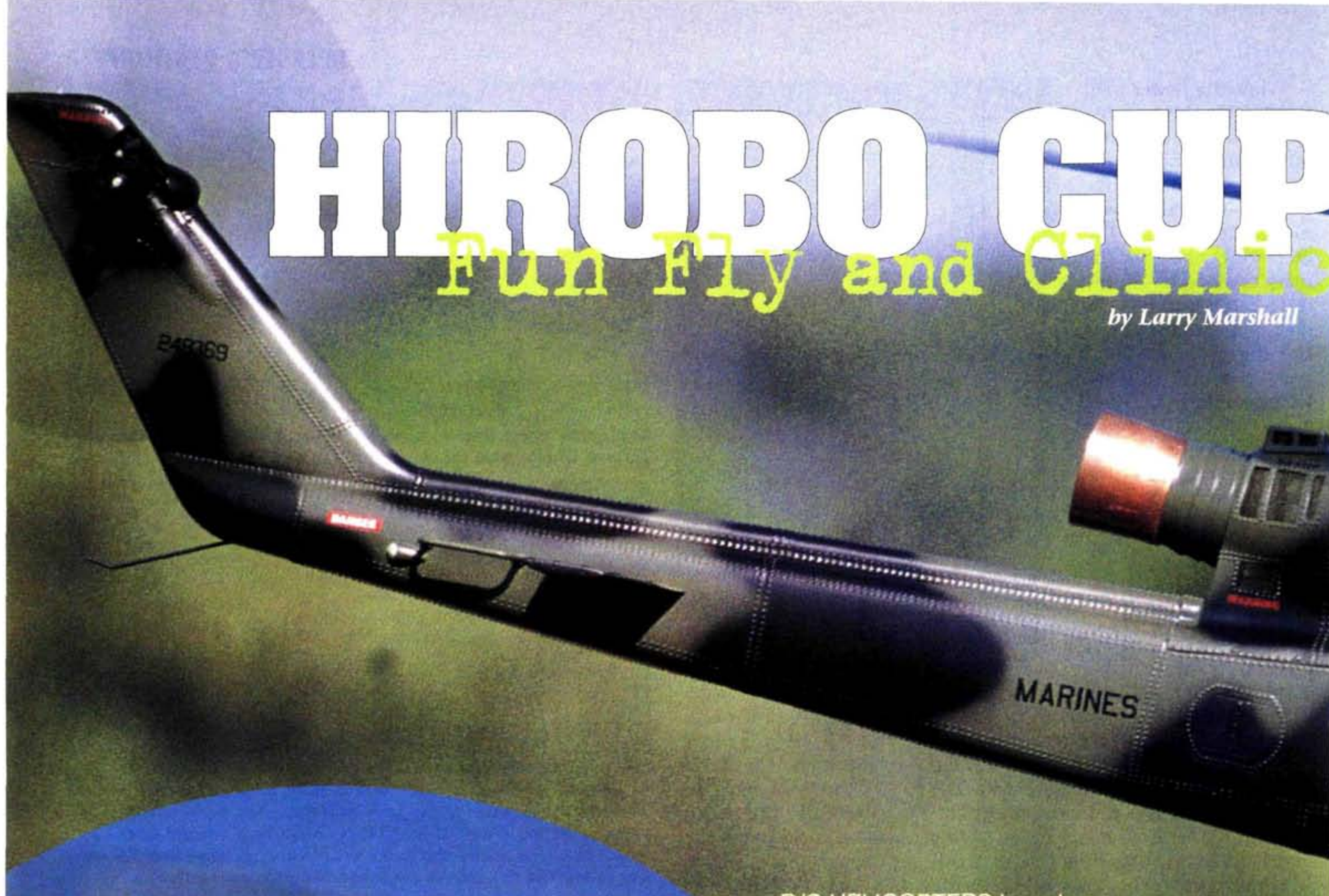
IN THE AIR

It stretches the imagination to picture this thing flying when the only means of propulsion is the flappers. It did fly; there is a video to prove it. It is sad that the development of such a unique aircraft stopped because of Spencer's health. Perhaps some creative modeler can pick up where Spencer left off and create a modern ornithopter.

If you have any interest in creating such an aircraft, Jack Stephenson is eager to help. He believes that a 1/4-scale Piper Cub kit could easily be used as the base aircraft, using the fuselage, tail group and much of the wing. He has sources for many of the unique parts as well as a ton of ideas as to how the aircraft can be built more easily and be a more efficient flyer. He even has some plans. Contact him at 22 Hook Rd., RFD 4, Gilford, NH 03246; (603) 293-7016.

HIROBO CUP
Fun Fly and Clinic

by Larry Marshall



R/C HELICOPTERS have been around for a long time. But modern radios, inexpensive gyros and easy-to-assemble helicopters have resulted in an influx of people who have acquired the title of "heli pilot." Most, but not all, heli fliers are younger than the average model airplane pilot, and these guys are taking helicopter aerobatics to new heights; you've got to see it to believe it. One of the best places to see it is at the Hirobo Cup Helicopter Fun Fly that's held every September.

Main image: Chris Endres took top honors in scale with his Hirobo AH-1 Cobra. Above: Joe Howard's Vario UH-1 was nothing short of awesome. Right: Ray St. Onge showed us how the masters fly 3D aerobatics with his X-cell 60.

Altech and Hirobo Promote Helicopter Fun

PHOTOS BY LARRY MARSHALL

Because they outgrew their old field, Altech*, the sponsors of the event, moved the event to a new location just west of Atlantic City, NJ. And if location is important in real estate, this field has a lot going for it. The field has been operated for 14 years by the Atlantic County SkyBlazers club. These guys have it pretty good, as they are given the use of the land by the Renault Wineries just down the road. Thus, when you decide to take a break from flying, you can take a tour of the winery and/or eat in their fine restaurant. To make things even better, there is a small restaurant (hamburgers and hot dogs) on the field, complete with shaded tables for your dining pleasure. In fact, all registered pilots at the Hirobo Cup were given a free lunch each day. Altech really knows how to throw a party.

Rick Bell's Hughes 300 lives up to the nickname ascribed to its full-scale counterpart: the "Bug."

But while the accommodations are excellent, it's the helicopters and the people who are the stars of this show. The sky was full of helicopters all weekend, and flying abilities ran the gamut from rank beginners to very skilled "pro" pilots. Getting flight time was easy, as the frequency control was well managed and waits for a pin were minimal. Jeff Green and his crew did a superb job of managing the flightline.

There were a number of beautiful scale helicopters being flown. Bob Bergo brought his Vario* EC135 Eurocopter; the mechanics of the multi-blade, shrouded tail rotor are truly incredible and showcase

THE ARMY SHOWED UP

Altech arranged to have the U.S. Army fly in one of its Bell AH-1 Cobras. Capt. John Gibbons (right) flew in and spent the day helping kids (and some big kids like me) get a chance to sit in one of the most advanced helicopters on the planet. It was quite a treat, and John's presence made it even more pleasant.

The "HueyCobra" was spun out of the Vietnam War, in which the UH-1 Huey evolved from a troop carrier to a gun and rocket platform. The need for more firepower and speed resulted in the creation of the Cobra series. First flown in 1965, the early

Cobras were supposed to act as escorts for the slower-flying transport and medevac Hueys, but they evolved into fully featured attack helicopters. The cockpit places the pilot in the rear and the copilot/weapons officer in front and a bit lower. It's an interesting arrangement that provides a great view forward for both crew members.

Vario workmanship to the fullest extent. Joe Howard was flying his Vario UH-l Huey, which he had detailed to the max; even the sound seemed scale. Chris Endres of Hicksville, NY, took top scale honors with his Hirobo* AH-1 Cobra; even the chin gun rotated. Rick Bell was flying his Hirobo Hughes 300. I was lucky enough to get to fly this one; it's as rock solid as a Shuttle, and it sure does look good in the air.

The 3D guys were out in force, and Ray St. Onge wowed the crowd over and over with his regular and consistent flights with his Miniature Aircraft* Excel 60. Ray is flying the new Futaba* heading-lock gyro and seems to like it a lot.

Len Sabato and his crew wore the JR* colors proudly, demonstrating why the Ergo 60 has become a well-respected

JR Ergo 60s have become one of the most popular .60-size helicopters with beginners and competitors alike.

competition helicopter in spite of its low price. Len also showed us the new stabilizer bar links being released by KSJ*. I've now got them on both my helicopters, as this little gizmo really adds rigidity to the tail-boom assembly.

Jeff Green, Altech's heli guru and CD

HELPING HANDS

One of the neat things about the Hirobo Cup is the "clinic." Altech sets up a large tent with many work tables under it. They bring a bunch of very qualified helicopter people to man it. It's quite a sight; people bring in their helicopters, and the experts help them with their problems—whether assembly, adjustment, or flying. Many folks benefited from this during the weekend; there's nothing like a frown turned to a smile by some expertise thrown into the mix.

The guys providing that expertise seemed tireless. Bob Neal (right) was helping some guys get their Hirobo Vertols flying. These twin-head helicopters are very complex in their setup but offer a unique sort of flying machine that's worth the effort.

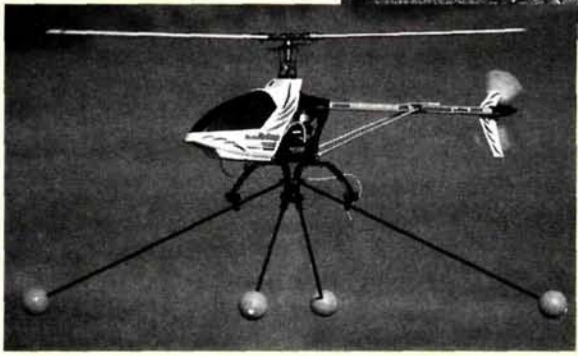
Randy Kubacki seemed to spend his weekend as a Hirobo Shuttle mechanic. I don't know how many helicopters he worked on during the weekend, but it was a bunch. Other guys were helping beginners get into the air, and I simply stood for a while and watched, remembering my first steps into helicopters. They're still fond memories of discovery and excitement, and you could see that on the faces of the new fliers, some of whom saw their helicopters fly for the first time.

Jeff Green spent time in the clinic as well, helping guys with their 3D setups, even flying their machines for them to assess the setup. Even for the basics, having an experienced heli guy fly your machine is an invaluable experience, as they can notice so much more than someone who has less experience. But then, that's what the members of the helicopter community are all about; they help one another have fun.

It would be really great if more of the industry folks held clinics like this one. Providing expertise brings success, and success brings repeat business. It was great to watch this process work so well for Altech.

Take the SHUTTLE CHALLENGE!

Kent Wien ran the Shuttle Challenge all day long. Here, Akiko Kimura, executive vice president of Altech, gets her first bit of stick time on a helicopter.



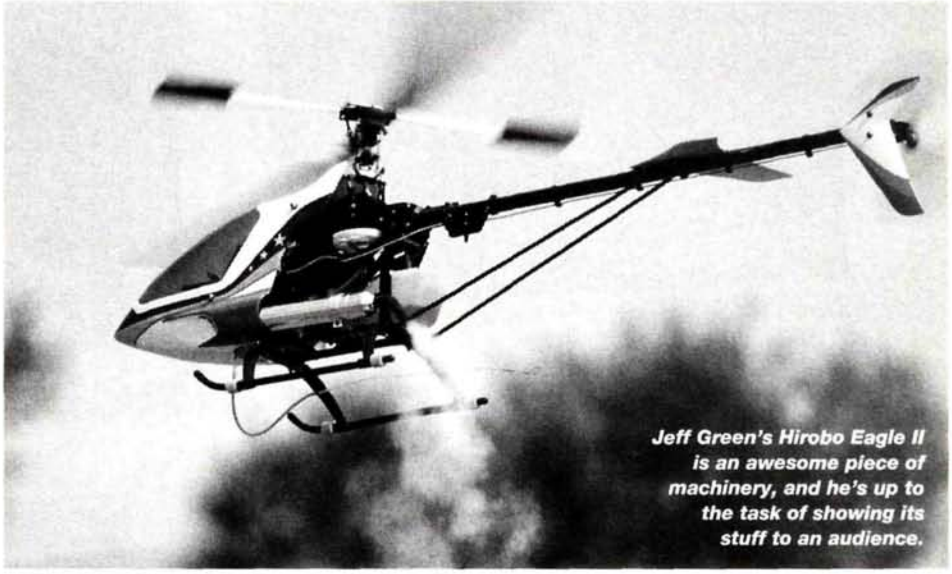
Imagine a line of people who have never flown a helicopter in their lives, taking turns at doing just that. Now, imagine it happening for an entire weekend. Then, imagine it happening for an entire weekend without going broke replacing all the broken helicopter parts.

That's exactly what happened at this year's Hirobo Cup. The reason was the Shuttle Challenge, Hirobo's latest product and the neatest training tool I've seen yet. The obvious part of the Challenge is the landing gear. It consists of four rods that attach to a center pod and splay outward into a flat arrangement when the helicopter is on the ground. Each of these rods functions independently; if you nose the heli into the ground, the front rod shoves the nose upward, leveling the helicopter as it hits the ground. I don't need to tell you the advantage of that feature.

But the Shuttle Challenge is a complete training system, not just training gear under a standard Shuttle. The secret is in the head design. The head itself is very stiff, and this prevents the blades from striking the boom if you bang it down hard. Hirobo also worked on the stability by using very heavy paddles and adjusting the Bell-Hiller mix so that the head is very stable in hover. As a result, the Altech folks goaded us by saying "Try to break it." I was too new to helicopters to try to bang a heli to earth, but Rick Bell took the challenge (pun intended). He hovered the heli out about 40 feet in front of us and then brought it back and down quickly, pounding the Challenge to the ground with the tail rotor low. With any other helicopter—including one with conventional training gear—we would have been heading for the parts store. But the Challenge just raised a little dust and was ready for someone else to try to break it. I even took a chance and did a bit of nose-in hovering, which I had never done before.

But the truly remarkable thing about the Challenge was all those folks who got stick time on a helicopter, even though they had never flown before. Kent Wien, one of Hirobo's sponsored pilots, ran this show all day Saturday, and the Challenge was in the air constantly. What became a "problem" for him was finding enough flight batteries (and charging them) to keep this machine flying hour after hour. Talk about smiles; they don't get any broader than that of a young kid on the sticks of a helicopter. There were lots of happy faces taking the Shuttle Challenge.

for the meet, made good use of the Hirobo Eagle II's capabilities. Jeff demonstrated extreme cool when potential disaster hit during one flight. He was a foot off the ground, inverted, when his Eagle's tail started shaking violently. He couldn't regain complete control of it. Rather than panicking, he simply (easy for me to say) flipped the heli upright and landed. As it turned out, his gyro had come loose and had dropped onto the collective servo, resulting in an "interesting" feedback problem when trying to control the tail. Yeah, Jeff!



Jeff Green's Hirobo Eagle II is an awesome piece of machinery, and he's up to the task of showing its stuff to an audience.

Maybe the most important thing about the Hirobo Cup is how comfortable it is for a beginner to go there and fly. I'm new to helicopters, yet I felt completely comfortable flying at the event. From what I could see, so did a lot of other folks; many were still dealing with the basics, many still flying with training gear. Everyone was helpful, and the more experienced pilots seemed to give you more than sufficient space so you weren't intimidated by other helicopters flying into your airspace. Because of this, I not only had fun, I learned a lot. So whether you're new to helicopters or an old hand, the Hirobo Cup is the place to be when September rolls around.

Century Helicopter's Falcon 46 is an economical way to get the flyability of a slightly larger helicopter.

**Addresses are listed alphabetically in the Index of Manufacturers on page 134.*

Apply Painted Markings

An easy masking technique for scale modelers

by Stephen Philbrick

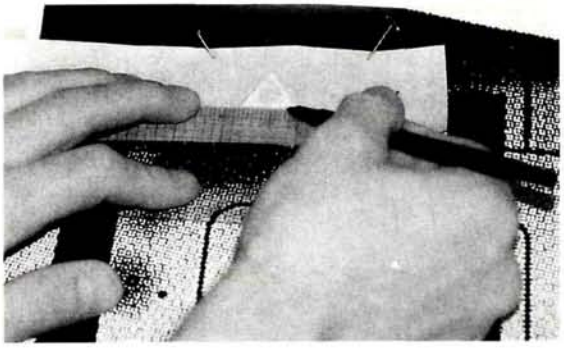
RECENTLY, MY BROTHER Whit and I built a 1/5-scale IMP* FW 190D. Since we were interested in scale competition, we decided that a painted finish, including the various markings and insignia, was necessary to be competitive. Decals (if available for the subject aircraft) can speed the finishing process but they leave a raised edge around the marking and limit the amount of weathering you can do to the model.

Painted markings, on the other hand, allowed us to weather the various markings and insignia along with the rest of the finish for a more realistic appearance. And, the markings are thinner (only as thick as the paint), are fuelproof and do not need a clear top coat.

To begin with, I'd suggest practicing the technique before you apply it to your finished model. Here's how we did our markings.

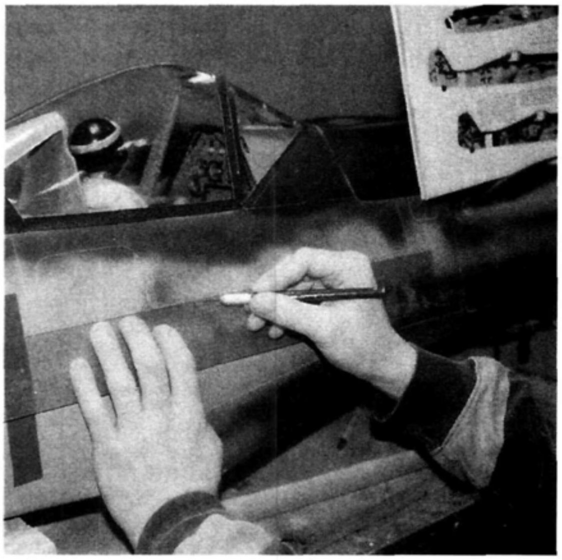
This FW 190 has a painted finish including all the scale markings. Decals might make the job easier, but painted markings and insignia allow the entire finish to be weathered for an authentic appearance.

1 Prepare for the task by studying scale documentation for your model. Here, we are using the Squadron/Signal Publications* book "Walk Around FW 190D" as a reference for color and markings. A proportional scale is useful in determining the proper scale factor to enlarge the various markings shown in the book to the size required for our model. Different scaling ratios may be required if markings are shown in the book at various scale sizes.



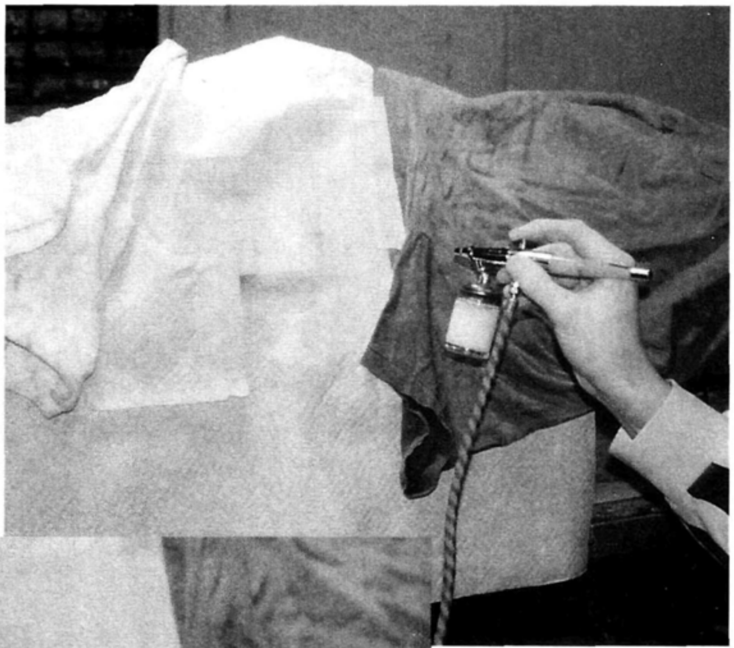
2 Using the proper scale ratio, enlarge the markings from the book to the size needed for your model. You can use a flatbed scanner to digitally enlarge the marking, or you can use a photocopier to enlarge it several times until you have the size required. Check the final enlargement against other "landmarks" on your model (hatches and panel lines) for proper size.

We used Frisk-It material, available at art supply stores, to make the painting template. We traced the markings from the enlargement using a dark colored pen. It may be necessary to correct for distortions to the marking caused by the enlargement process. Use a straightedge and make sure that the lines are straight or parallel where required.

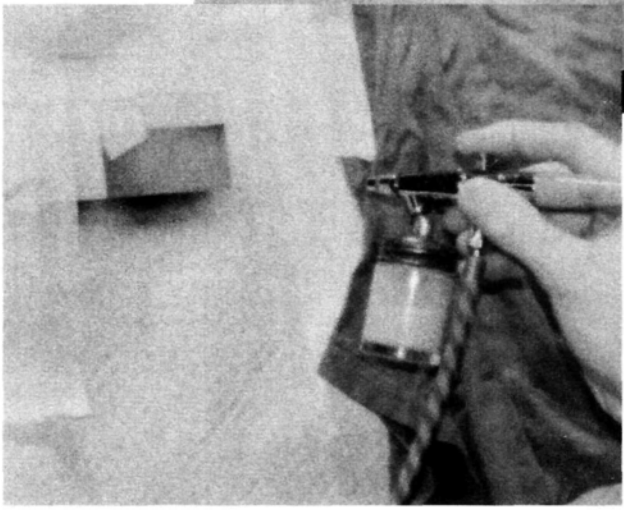


3 Remove the masking material from its backing paper and carefully position it on the model. Make sure that the surface of the model is clean and dust-free. Smooth the masking material into place by gently rubbing it to remove any air bubbles trapped beneath it.

We cut the masking material using a sharp no. 11 hobby blade after the mask has been applied to the model. This way, you get a cleaner cut line and in general, it is easier to apply the material before openings are cut into it. Now carefully remove the unwanted portion of the mask. Cover the rest of the model with newspaper or wrapping paper and tape it into place around the masking material. Used masking tape is good for this, as it is less tacky than new tape and there is less chance of damaging the finish when it is removed.

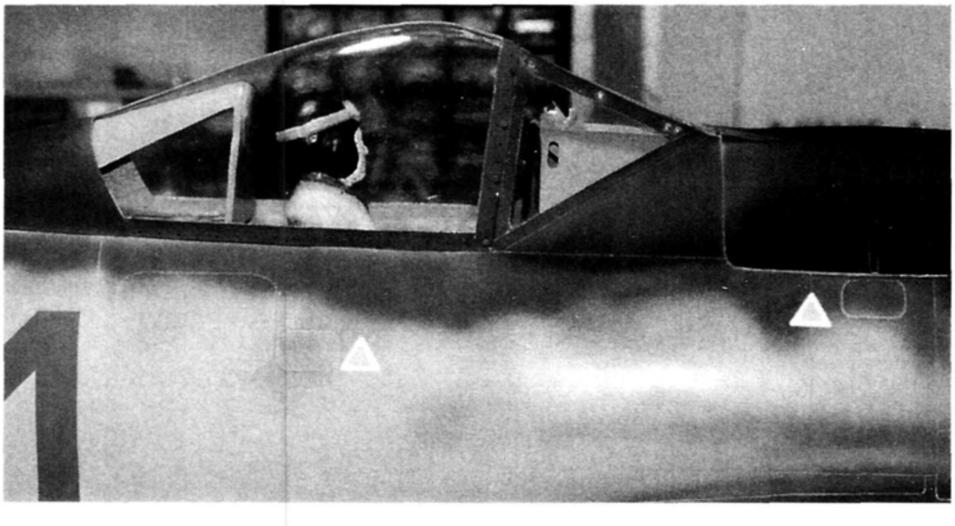


4 When spraying the markings, seal the edges of the mask with a light coat of paint. Allow a minute or two for the paint to settle, then follow this with broad, even strokes of paint to finish the marking. Wait until the paint has dried but not completely hardened before peeling off the mask. Remove the mask slowly and carefully, making sure not to touch the painted area.



5 For multicolored markings, start with the lightest color paint then add the darker portions after the previous color has completely dried. Apply the mask for each color and repeat the process. When the last color has been applied, remove the mask and wait for it to completely harden, then do any touchup work or weathering. Before the paint completely hardens, you can remove any imperfections with a small amount of solvent applied with a paper towel or a cotton swab. You might also want to use this technique to blend or dull the edges of the markings, depending on the effect you are trying to create. Remember: not all markings on warbirds were picture perfect; some were hastily applied in the field by hand or with rough-cut templates.

Remember: not all markings on warbirds were picture perfect; some were hastily applied in the field.



6 Here, the completed triangle markings are finished. The number 1, as well as all the other markings on the FW 190, were applied in the same way. The finished model looks great and when weathered, the effect should be very pleasing and look quite authentic.

**Addresses are listed alphabetically in the Index of Manufacturers on page 134.*

A 60-inch-span aerobat

Jon Staudacher's S-300 was introduced at the National Aerobatic Championships in 1990. Since then, it has become the dominant unlimited aerobatic monoplane in the U.S. and the highest placing American aircraft at the U.S. National Aerobatic Championships.

The Carl Goldberg Models* Staudacher S-300 GS kit was designed by Jack Butler. The balsa, lite-ply and other parts are well marked and packaged, and the kit comes with two sheets of full-size plans, a 40-page, illustrated instruction book and all hardware, including formed aluminum landing gear, a motor mount, all linkage components and blind-nuts. A two-piece ABS cowl, wheel pants, canopy and a set of peel-and-stick Mylar decals are also included. To get the S-300 GS into the air, you'll need adhesives, a .45 to .61 2-stroke or .46 to .80 4-stroke engine, a 4-channel radio, wheels, covering material and a fuel tank.

Carl Goldberg Models

Staudacher S-300 GS

by Ron Faanes

BUILDING THE FLYING SURFACES

The kit contains high-quality balsa for the lifting surfaces and razor-cut lite-ply for the fuselage and engine box. I used Goldberg Super Jet, Tite-Bond, Goldberg Jet Epoxy and Model Mate glues.

The tail feathers are conventional construction with 1/16-inch balsa sheeting over 3/16 inch-square frames. The elevator and rudder are open construction of square 5/16-inch stock. The plans call for laminating 1/18- and 1/16-inch precut balsa horn mounts, but I chose to cut the 1/8-inch pieces out of lite-ply for added strength. The instructions indicate that the trailing edge of the fin is made out of two 3/16x5/16-inch balsa sticks, but the plans do not show this. A call to Goldberg Technical Assistance assured me only a single 3/16x5/16-inch stick was needed. After assembling the empennage, I marked the hinge lines with the centerline marker provided in the kit. I made the hinge slots with a Harry Higley* hinging tool, then shaped the leading and trailing edges according to the plans using the beveling tools included in the kit.

SPECIFICATIONS

Manufacturer: Carl Goldberg Models Inc.

Model name: Staudacher S-300 GS

Type: aerobatic

Length: 48.5 in.

Wingspan: 60 in.

Wing area: 690 sq. in.

Weight: 9 lb., 6 oz.

Wing loading: 22.8 oz./sq. ft.

Engine recommended: .45 to .61 2-stroke or .46 to .80 4-stroke

Engine used: O.S. Surpass .91

Prop used: 13x8 Master Airscrew

Radio req'd: 4-channel with 6 servos

List price: $134.99

Features: balsa and lite-ply kit with two sheets of full-size plans, 40-page, illustrated instructions and complete hardware package, including formed aluminum landing gear, all linkage components, blind-nuts and a motor mount. Also included are a two-piece ABS cowl, wheel pants, canopy and a set of peel-and-stick Mylar decals.

Comments: in building the S-300, extra effort should be made to achieve a lighter flying weight than the 9.5-pound dry weight of my bird; this should significantly enhance aerobatic performance.

Hits
- Well-written, illustrated instructions and full-size plans.
- Ease of construction.
- Stable flight characteristics.

Misses
- The 5⁄64-inch balsa ribs and sheeting used in the wing may save weight, but I think they are too thin.

FLIGHT PERFORMANCE

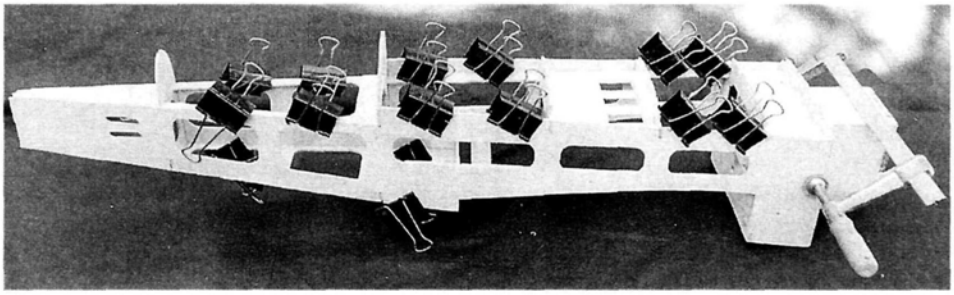
• TAKEOFF AND LANDING
After a few rights and lefts to test ground handling, the S-300 was turned into the wind with full down-elevator. As the model neared airspeed, I neutralized elevator, and the tail lifted with marginal up-elevator. Takeoff was smooth, with no corrections necessary. Ground handling is very predictable. The S-300 tracks straight, responds quickly to rudder control and has no tendency to nose over. Landing is a breeze with no tendency to snap. Put it on the centerline, cut the power, let it sink on its own, keep it straight and it settles in on three points.

• HIGH-SPEED FLIGHT
The control deflections recommended in the manual (3/8 inch at low and 5/8 inch at high) for all surfaces are too high. With the suggested elevator throw, there was a significant tendency to snap when full up was given, and the roll rate is brisk, to say the least. This tendency to snap disappeared when elevator deflection was reduced. The S-300 is not a fast airplane with the O.S. Surpass .91 and 13x8 Master Airscrew prop, but it is very stable and capable of all competition maneuvers.

• LOW SPEED PERFORMANCE
Slow flight is very predictable, with no tendency to stall prematurely. When a stall is initiated, it is forward and not off the wing.

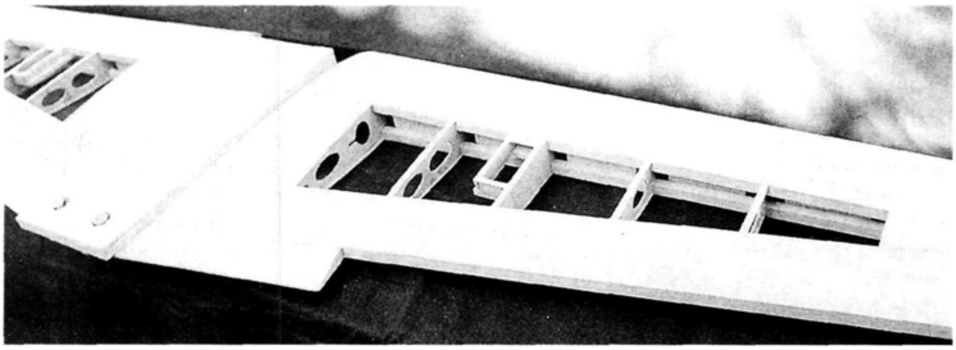
• AEROBATICS
The S-300 performed advanced maneuvers such as a knife-edge loop, rolling circle and Lomcevak when in the hands of Dan Carozza, who was impressed with its aerobatic capabilities. The O.S. Surpass provided ample power with good vertical performance. I must mention again that elevator throw is crucial to a predictable flying S-300. Too much throw will result in an instantaneous snap at all speeds. A general comment on flight characteristics: my model has a the tendency to mush through a turn unless I mix the control inputs of rudder, elevator and aileron.

The wing is built upside-down and, if you have enough room, it's best to build the entire wing at once. I encountered a few minor glitches when building the wing. The arrows that line up the plan sheets to build the entire wing did not match exactly. I used the main spar as a reference with the arrows as closely aligned as possible. Ribs 2 and 6 were mismarked, number 1 ribs were too long, and 2 and 4 were too short. These discrepancies are more than likely a result of this being a first-run kit. The die-cutting of the ribs is excellent.



I used office clamps to hold the fuselage pieces together while the epoxy dried. All the parts fit very well.

The trailing-edge support tabs on each rib are scored for easy removal after ribs and spars have been secured, but because they're so thin, they snapped off while I was installing them—frustrating, to say the least. Pay close attention to lining up rib 3, which is angled to allow a close fit to the fuselage. I needed to put in spacers to close this gap after positioning the wing. A neat touch is the incorporation of the wing servo tray into the construction sequence. The servo tray is finished with die-cut sheeting, making a nicely finished servo mount. Shear webs are precut. Sheeting and joining panels is straightforward. I really liked the shaped leading edge, which is grooved to accept the ribs and support the sheeting; this produced a leading edge that required very little sanding before covering. For added security, I added a 3/8-inch basswood dihedral brace between the designed 1/8-inch plywood braces supplied in the kit. The ailerons are precut, so hinging is all that is required before final assembly.



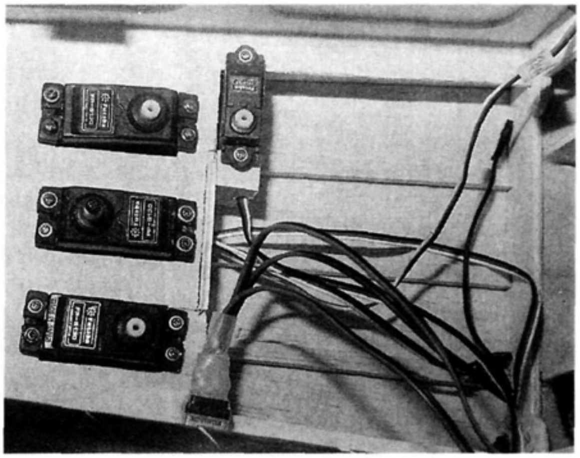
The wing is built out of high-quality balsa and features really nice, die-cut ribs. Sheeting and joining the wings is straightforward.

FUSELAGE

The S-300 GS fuselage is made of 1/8-inch lite-ply. A builder would need to be very careless to not produce a straight fuselage. The sides, top and bottom are cut to accept die-cut formers, and all parts fit very well. I used large office and cabinet clamps and rubber bands instead of the masking tape suggested in the instruction booklet for alignment before gluing. The servo-mounting holes are precut into the top of the fuselage, which saves time in constructing a servo tray. The 1/32-inch-thick ply turtle-deck sheeting went on easily. I chose to carve a balsa block to finish off the rear of the turtle deck. This allows removal of the tail feathers for covering prior to assembly. A dummy spacer used in place of the horizontal stabilizer

allowed final sanding without the stabilizer in place. Goldberg Model Mate was used to feather the edges of the sheeting to the fuselage sides.

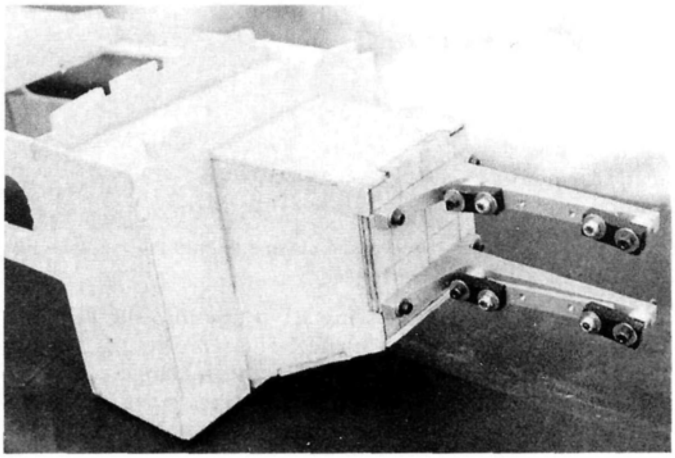
The engine box and firewall were easy to assemble. For added strength, I used four $\frac{3}{32}$-inch spruce dowels at each dovetail and through the lite-ply into the $\frac{3}{8}$-inch firewall. The landing-gear block is put in place during this phase of construction. I used spruce dowels here, too, for added strength. A Dave Brown Hobbies* Von Linsowe soft mount was used to support the O.S. .91 Surpass with a Slimline* Pitts-style muffler.



There's more than enough room in the fuselage for the servos.

COVERING AND FINAL ASSEMBLY

The color scheme I chose was that of Diane Hakala, who flies the S-300 GS in competition. Goldberg Ultracote was used for the entire project. This material is very easy to work with and goes around corners without leaving wrinkles. I experimented with Ultracote Plus, which is self-sticking and heat-shrinkable. I used this material where colors overlapped and for the lettering, which I cut out with a Roland* Stikit Cutter and Software.



The engine box and firewall are easy to assemble. I used a Dave Brown Von Linsowe soft mount to support the O.S. .91 Surpass engine.

Throughout the covering process, I used the new Harry Higley trimming tool.

I used two Futaba 130 servos for the elevator and one for the pull/pull rudder setup. Low-profile 9102 Futaba servos are required for the ailerons, as a standard servo will not fit in the servo tray without protruding through the top of the wing.

The Mylar decal sheet did not come with an instrument panel. While going through the exhibitor tent at Top Gun, I met Larry Maurer, president of Small Aircraft Components, and he offered to custom-build one for the S-300. I sprayed 600-grit wet/dry sandpaper with the paint I used for the cockpit to achieve a non-glare dashboard; 3M spray adhesive was used to attach to the painted sandpaper. I painted a DGA* pilot figure, glued it into place and attached the canopy.

Before attaching the empennage, I drilled holes to accommodate a Sullivan* scale flying wires kit. Attaching the flying wires was a breeze, and the result was a finished, very realistic, adjustable setup.

The "Shell" and "International Aerobatics" logos were purchased from Model Graphics*. The remaining lettering was supplied in the kit or cut out of Goldberg Ultracote Plus.

The final flying weight was 9.5 pounds. Using a Great Planes* Balancing apparatus and a Robart* Deflection Gauge, the CG and control-surface movements were set according to the instructions. Balance was perfect—right on the main spar. After a preflight and radio-range check, the Surpass was fired up. The Slimline muffler performed as expected, producing only 90 decibels at 9 feet with a 13x8 Master Airscrew prop.

SUMMARY

The Goldberg Staudacher S-300 is a high-quality kit, is easily assembled and has great flight characteristics that advanced pilots will appreciate. I solicited assessments from Dan Carrozza, Richard Paul, Vince Perillo and Jim Onorato of the WRAMs, as all had opportunity to take a test flight. All, me included, give high marks in all areas and recommend that a larger version be considered.

**Addresses are listed alphabetically in the Index of Manufacturers on page 134.*

MODEL AIRPLANE NEWS
FIELD & BENCH
REVIEW

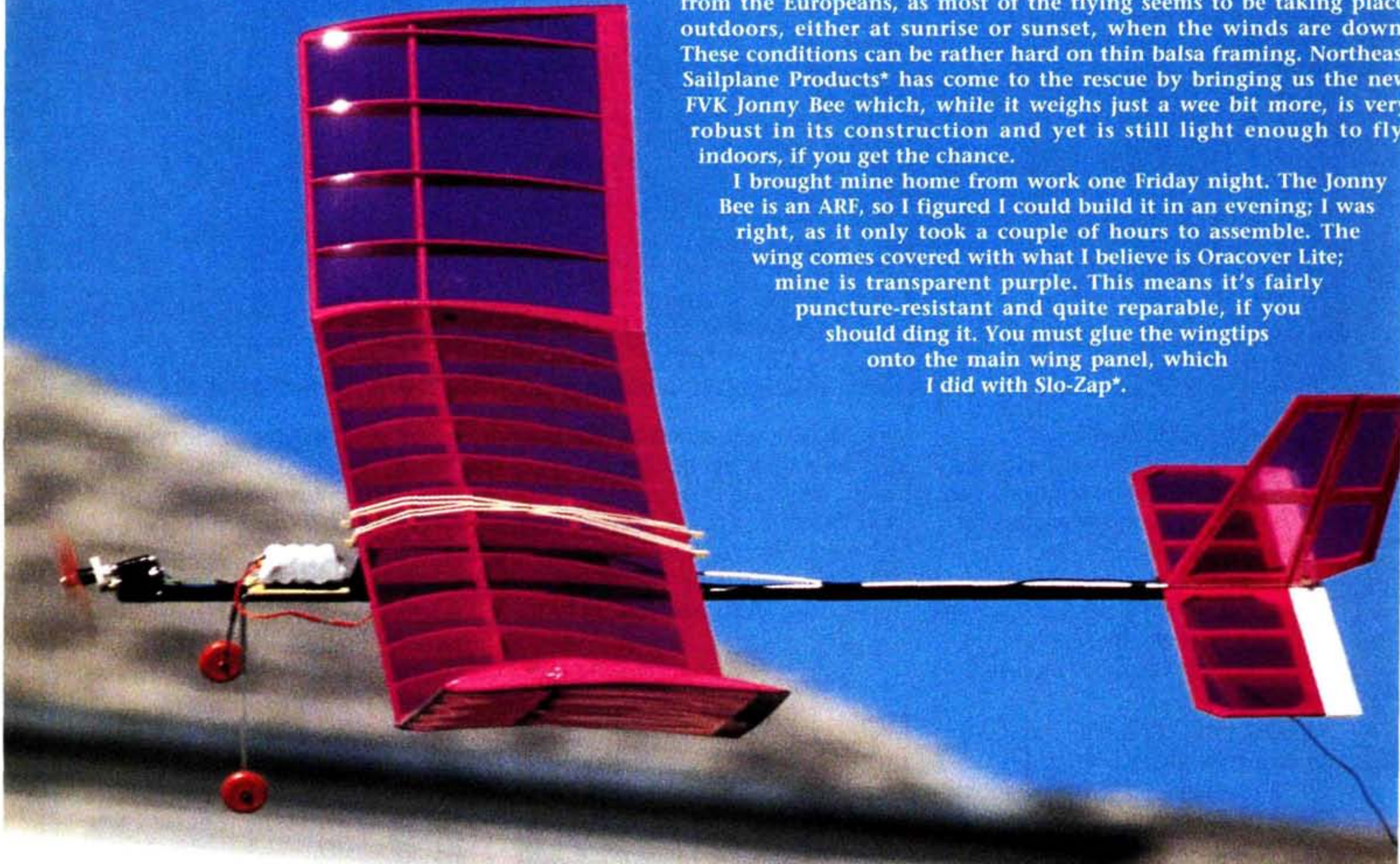
by Larry Marshall

OVER THE LAST FEW years, European modelers have discovered that flying very lightly loaded, electric-powered models indoors is a lot of fun. They now regularly have indoor fun flys with limbo contests, touch-and-go's on a card table, and even slow-fly pylon racing.

Well, those airplanes are starting to make their way to North America, and interest in them is increasing at a rapid rate. The first commercial example we saw was the Bleriot from Hobby Lobby. It's a nice flying, very lightly built plane. They are very popular.

But Americans seem to be enjoying these planes a bit differently from the Europeans, as most of the flying seems to be taking place outdoors, either at sunrise or sunset, when the winds are down. These conditions can be rather hard on thin balsa framing. Northeast Sailplane Products* has come to the rescue by bringing us the new FVK Jonny Bee which, while it weighs just a wee bit more, is very robust in its construction and yet is still light enough to fly indoors, if you get the chance.

I brought mine home from work one Friday night. The Jonny Bee is an ARF, so I figured I could build it in an evening; I was right, as it only took a couple of hours to assemble. The wing comes covered with what I believe is Oracover Lite; mine is transparent purple. This means it's fairly puncture-resistant and quite reparable, if you should ding it. You must glue the wingtips onto the main wing panel, which I did with Slo-Zap*.



NORTHEAST SAILPLANE PRODUCTS/FVK
JONNY BEE
Slow flying is fun

SPECIFICATIONS

Model: FVK Jonny Bee

Type: Light flier

Distributor: Northeast Sailplane Products

Wingspan: 36 in.

Wing area: 296 sq. in.

Wing loading: 3.6 oz./sq. ft.

Length: 32 in.

Weight: 7.5 oz.

Motor/battery: motor included; 9-50mAh battery used

No. of channels req'd: 3 (throttle, elevator, rudder)

Radio used: JR 783 with Hitec 555 receiver and two HS-50 servos

List price: $149.95

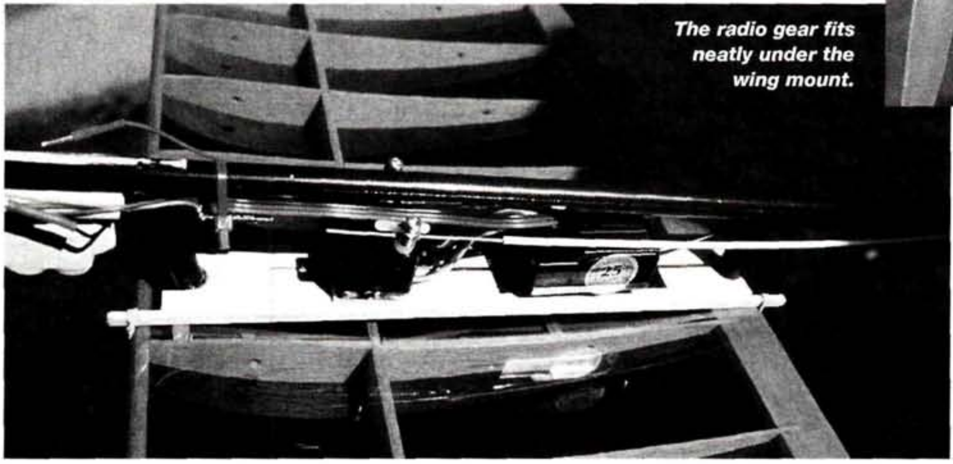
Features: *prefabricated* and covered flying surfaces, pre-installed motor, control rods and wing pylon. Covered with lightweight, reparable plastic covering.

Comments: this is a fun plane that defines a new class of light but very strong outdoor light fliers.

Hits
- High degree of pre-assembly.
- Motor and battery included.
- Repairable covering.
- Good flight characteristics.

Misses
- None.

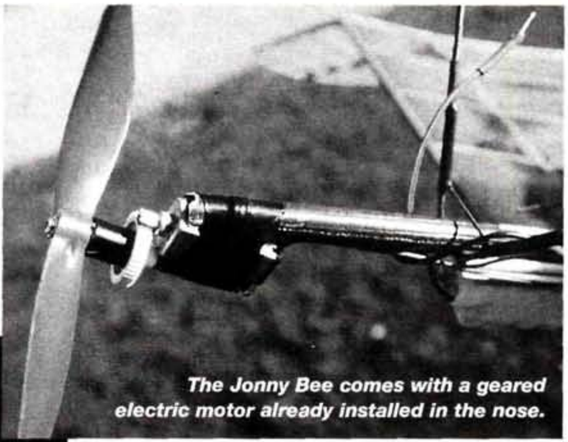
The fuselage is a carbon-fiber tube. The control rods are already in place, as are the motor, battery platform and wing pylon. To install the wheels, you simply plug them into tubes that are already attached to the fuselage. The tail surfaces are also precovered, and all you must do is glue them to the fuselage and install the control horns. I used Slo-Zap to glue the stab to the fuselage and Zap CA+ to glue the fin to the stab.


The radio gear fits neatly under the wing mount.

The only thing left to do was to install the radio gear. I used Hitec's* new 555 receiver and two of its new HS-50 servos; this gear is ideal for the plane. Installation method is left up to the builder, so I just used Velcro®-brand fastener to hold the receiver in place. I stuck the two servos together using some two-sided foam tape and then mounted this unit to the underside of the wing mount using more foam tape. That was all there was to it.

To power the plane, I used a 9-50mAh battery, the included geared motor and its 7-inch propeller, and I controlled throttle using the new Konitronics* 10 controller. (I'm afraid the photos won't show this device very well, as it's about half the size of a postage stamp and not much thicker.) It has BEC and a current capacity of 5 amps, which is more than enough for these slow fliers. To switch the motor on and off, I simply used tiny pin connectors between the battery and controller, and I disconnected the positive lead to turn off the system. With this setup, my Jonny Bee weighed 7.5 ounces.

Unfortunately, when I finished the plane, it was dark outside. But I was really itching to see the Jonny Bee fly, so I went into the front yard and took a look. Pretty dark, I thought; but then, there was that street light down the way, and it was casting some light in my direction. So I launched (yeah, I know; it was a bad idea). There isn't much to launching the Jonny Bee, as it needs very little airspeed to fly. I made a circuit over the street and was having a good time. Then, disaster struck. I had climbed a bit higher, and an unseen power line leaped


The Jonny Bee comes with a geared electric motor already installed in the nose.

out of the dark and took a slap at my Jonny Bee, spinning it nose first into the middle of the street. Right then, I realized I hadn't taken any photos of it yet.

Surprisingly, the only damage was that the motor had been shoved rearward a bit. I pulled it forward, and it was ready to go again. But my pride had been damaged enough for one night, so I decided to wait for the camera.

Flying the Jonny Bee in daylight is a lot more fun. The next afternoon at the local schoolyard, I flew it until the sun went down. With the 50mAh cells, I get about 3.5 minutes of flight time, but it's easy enough to move to larger cells if more duration is desired.

The Jonny Bee is an easy way to get into the world of slow fliers, and it performs really well. It has a more robust nature than some of the other slow fliers; I really like it, as it suits my flying needs better. Give one a try. Right now, I'm figuring out how to put some lights on mine so I can try front-yard flying again.

*Addresses are listed alphabetically in the Index of Manufacturers on page 134.

HITEC MICRO-GEAR: WHEN QUALITY MATTERS

The folks at Hitec have always been at the top of the heap when it comes to producing solid, small radio gear. They don't always do it the cheapest, but they pay attention to the details that matter to discriminating modelers.

This is evidenced in the company's newest small products, the Hitec 555 receiver and the tiny HS-50 servos. The receiver brings to micro-systems the same dual-conversion FM system as has become the standard in full-size receivers. Its small footprint (1.6x1.1x0.7 inches; 0.77 ounces) ensures that it will fit in the smallest of model aircraft. It has worked extremely well in my Jonny Bee.

The HS-50s are by far the best sub-microservos around. I base that statement on what's inside. The biggest problem people have with these tiny servos is the loosening of the drive gear on the potentiometer drive shaft. The reason for this is that most of the imported microservos have a simple wire shaft and a nylon gear that's simply press-fit onto it; this keeps manufacturing costs low.

Hitec, as is its way, would rather have to sell its servo for a few more dollars and have that servo continue to march onward, working as well after 100 flights as it did when it came out of the box. Thus, rather than a wire shaft, it has a machined brass potentiometer shaft, with a flat machined on it and a matching flat molded into the drive gear. This provides a solid, long-lasting connection between the two. Thanks, Hitec; we needed that.

The HS-50s produce 11 ounces of torque at 6 volts and weigh only 0.22 ounces. They will fit just about anywhere because of their small size (0.82x0.44x0.87 inches). Thus, two of these servos, along with the Hitec 555, added only 1.2 ounces to my Jonny Bee. This is the weight of a single standard-size servo. The result is a bulletproof (well, almost) receiver/control system.

As an aside, the Hitec 555 has only been available for JR, Futaba and Hitec systems, but I've heard that Hitec has decided to make this receiver available for the older Airtronics Sanwa connectors.

A 1/4-scale WW I British fighter for land or sea

PHOTOS BY JOHN TANZER

SPECIFICATIONS

Model name: Sopwith Baby

Type: ¼-scale WW I British fighter-bomber, floatplane and land plane

Wingspan: 77 in.

Length: 50 in.

Weight: 20 to 22 lb.

Wing area: 2,387 sq in.

Wing loading: 21 oz./sq. ft.

Airfoil: Semisymmetrical.

Radio: 4 (rudder, elevator, ailerons, throttle)

Engine used: 3.7ci Roper

Comments: the Sopwith Baby is an unusual and very attractive WW I biplane that is relatively easy to build and fly. Construction is typical built-up balsa and spruce: flying wires are not required; the wings are strong enough without them. The cabane struts are made of wood and are removable, so wing alignment and model disassembly are not complicated.

Sopwith Baby
SEA SCOUT

by John Tanzer

THE "BABY" WAS a refinement of the prewar Sopwith "Tabloid" and "Schneider" racing biplanes. It was powered by either a 110hp or 130hp Clerget rotary engine housed in a horseshoe-shape (inverted-U) cowl. Armament varied; some aircraft were fitted with an upward-and-forward-firing Lewis gun, and others were equipped with a synchronized forward-firing Vickers gun. The Baby could carry two 65-pound bombs for antisubmarine patrols. The floats were twin, non-stepped, box, "sea-sled" type with a tail float and an aft water rudder. For land use, I replaced the box floats with wheel and axle gear using the original struts plus new Shorthorn skids and axle saddles. I replaced the tail float with a steerable tailskid. The Sopwith Baby saw widespread use with the Royal Naval Air Service and was produced under license by British companies, including Blackburn and Fairey.

I chose to model a Blackburn-built Sopwith Baby floatplane, which was based at Great Yarmouth, England, during 1919. It had a red-and-white checkerboard cowl. I also built the landing gear and tailskid. Converting from floats to landing gear takes only minutes. I had saved a 3-view of the Baby from the February 1978 issue of *Model Airplane News*. After 20 years, it came in handy as a guide to design and build a good replica.

The model is ¼ scale, and some accessories, such as guns, wheels, cowls and pilots, are available. I used a cowl from Fiberglass Specialties* (part no. MCB-8), and it worked out fine. I used an instrument panel kit from Arizona Model Aircrafters*. This is an excellent kit, and it makes a realistic-looking instrument panel for WW I aircraft. I originally installed a Q-42 engine and replaced the stock engine mount with a flat steel plate mount to keep it short. The nose on the Baby is very short, and the plane did come out tail-heavy. To balance it, two pounds were needed in the nose. I decided to install a 3.7ci Roper engine, as it is two pounds heavier and can turn a 24x8 propeller at 6,000rpm. The engine runs smoothly with more-than-enough power.

FLIGHT PERFORMANCE

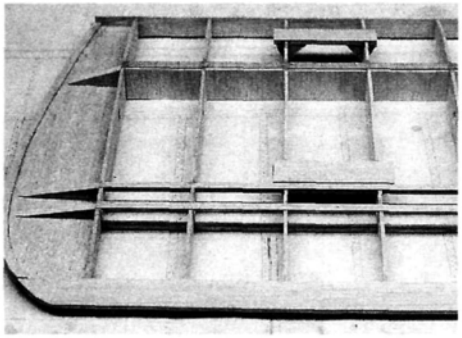
The Sopwith "Baby" flies equally well from land and water. As a land plane, a G-38 will fly it realistically, but I prefer the Roper 3.7ci engine. Flying off water, a 24x8 propeller does a good job of overcoming all the additional drag. The semisymmetrical airfoil is very forgiving, and trim changes with power changes are minimal.

• TAKEOFF AND LANDING

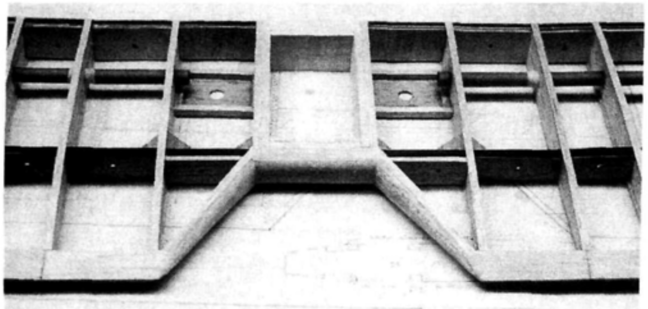
Takeoffs are easy thanks to the steerable tailskid. Taxi out to the middle of the runway, add power slowly, use rudder to keep it straight, and lift off and fly straight out. To make a good landing, keep some power on till just before touchdown; try to make gentle wheel landings. Try to fly only from a well-mowed grass field; a hard nose-over can result in gear damage.

• GENERAL FLIGHT CHARACTERISTICS

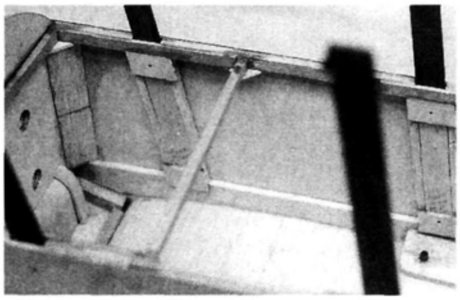
This is a very stable flying aircraft; it will do all of the WW I-type maneuvers with ease. It will loop from level flight at half throttle. The ailerons are very effective, and rolls are very good. Some coordinated rudder is needed for nice banked turns. Where this plane shines is in slow flybys and gentle touch-and-go's. While flying at the 1998 Warbirds Over Delaware event, with the late-afternoon sun shining behind me, the Sopwith Baby looked spectacular. I could have sworn that I was at Old Rhinebeck Aerodrome, NY.



Wing construction is typical and uses shear webbing on the spars for added strength. Note the $\frac{1}{4}$-inch-ply strut plates.



The upper wing center-section detail. Note that the cardboard tubes that guide the servo leads to the aileron servos have already been installed on the wing.



Here the cabane struts are in place so the top wing can be trial-fitted. Note how the struts fit in the ply channels.

CONSTRUCTION

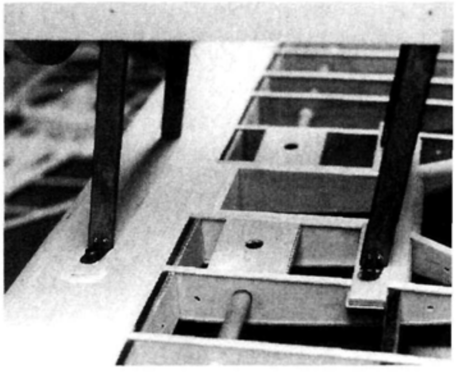
This is a builders' project—not difficult, but time-consuming. Balsa, spruce, plywood, lite-ply and some metal parts are used.

• **Wings.** The four outer wing panels are identical: two left and two right; the upper and lower center sections differ slightly. The semisymmetrical ribs have a flat spot between the lower spars that allows each wing to be built flat on the workbench. I started by cutting out all the parts to make two wing kits.

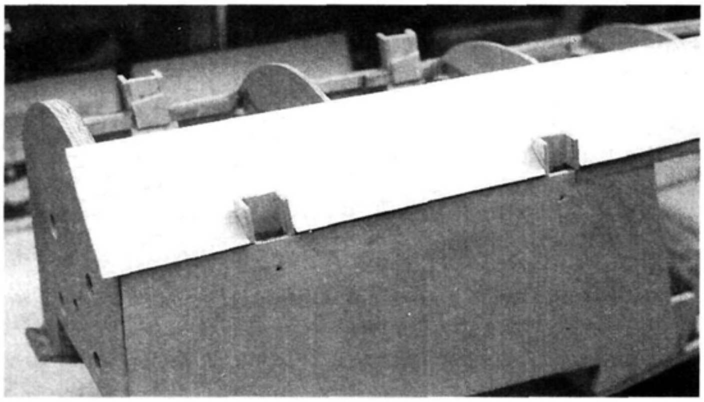
Pin down the $\frac{1}{4}$x$\frac{3}{8}$-inch spruce main spars. Use a rib as a gauge to locate and pin down the $\frac{1}{4}$-inch-square spruce rear spar. Note that the ribs at the ailerons have $\frac{1}{8}$x$\frac{1}{4}$-inch notches. Also, when building the top wing panel, use lite-ply for the R-3 ribs. When building the lower wing panel, use lite-ply for the R-2 ribs. Now Zap* all the ribs into place. Add the top spars and the $\frac{3}{32}$x$\frac{7}{8}$-inch subleading edge. Tape the two $\frac{1}{16}$x1-inch trailing edge (TE) sheets together at the rear. Open these sheets like a book and Zap them to the rib ends. This ensures a straight TE. Glue in R1-AR rib tail at the aileron leaving a $\frac{1}{16}$-inch gap.

Remove the wing panel from the plan and glue in the $\frac{1}{8}$x$\frac{1}{4}$-inch strips at the aileron, then glue the $\frac{3}{32}$-inch vertical-grain shear webs in place and add the $\frac{1}{8}$-inch-balsa wingtip. Glue in the $\frac{1}{4}$-inch-ply interplane strut plates and reinforce them with balsa triangle stock. Build the rest of the wing panels in the same way, but remember that the top wing has the $\frac{1}{4}$-inch-ply plates on the bottom and the lower wing has them on top.

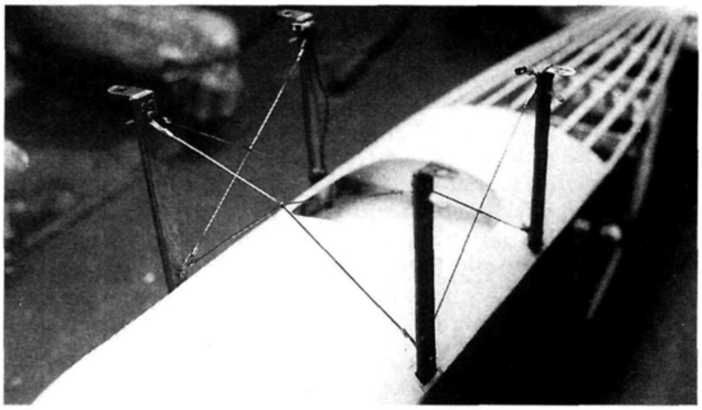
Use the same wing plan to build two upper and two lower wing panels. Build the upper and lower wing center sections using the same building system. Before you join the wing panels to the center section, install the $\frac{1}{2}$-inch paper tubes. Cut halfway through the bottom of the tube at the dihedral break so that the tube will bend up. With the center section pinned flat on the workbench, slide the wing panels onto it, and prop up both tips $\frac{7}{8}$ inch at the last rib. This gives the proper dihedral angle. Use epoxy to glue in the ply dihedral braces. Next, glue the $\frac{1}{4}$-inch-balsa ribs R1-D1, R1-D2, R1-D3. With the wing removed from the bench, glue in the $\frac{1}{4}$-inch-ply cabane and interplane strut plates and reinforce them with triangle stock. Note: all $\frac{1}{4}$-inch-ply plates are $\frac{1}{16}$ inch above the rib surface and will be flush with $\frac{1}{16}$-inch-balsa skin. Now glue on the $\frac{1}{16}$x$\frac{1}{4}$-inch-balsa sheeting, cutting around the $\frac{1}{4}$-inch-ply plates then attach all the $\frac{1}{16}$x$\frac{1}{4}$-inch-balsa capstrips. When sheeting the top, weight down the center



The upper wing attachment detail. Note the use of carbon fiber on the aft spars. No flying wires are needed.

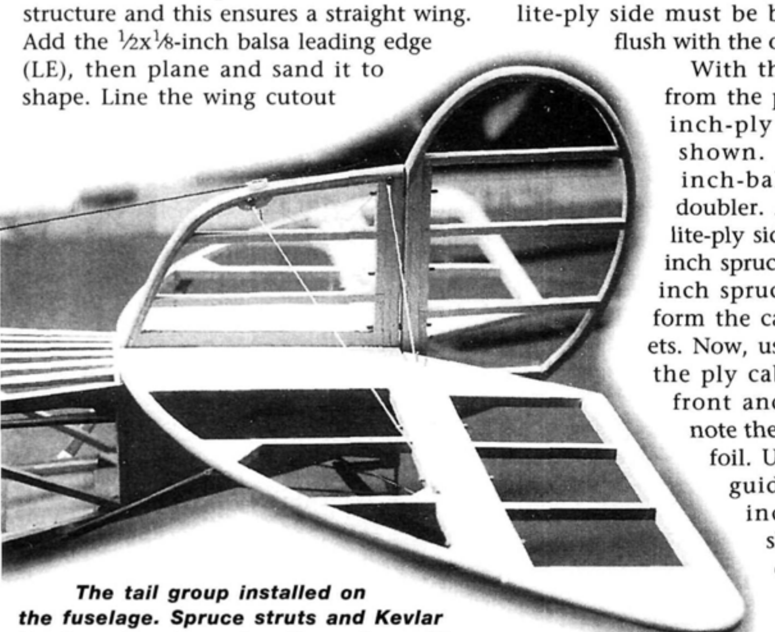


Balsa sheeting is applied to the top of the fuselage. The tops of the cabane channels are notched into the sheeting. The tops are made of balsa and will be sanded flush with the sheeting.



One-sixteenth-inch music-wire braces soldered to Du-Bro 2-56 solder links add much needed torsional strength to the cabane struts.

section so it remains flat on the workbench, glue on the sheeting, then do the same with the other wing panels, one side at a time. The top sheet forms a D-tube structure and this ensures a straight wing. Add the 1/2x1/8-inch balsa leading edge (LE), then plane and sand it to shape. Line the wing cutout and center bay with 1/4-inch balsa (the center bay will remain open).



The tail group installed on the fuselage. Spruce struts and Kevlar bracing wires strengthen the surfaces. The outline is made of laminated balsa strips.

Now is the time to cut out the ailerons; use the rear spar as a guide. Glue in balsa hinge blocks, then sand them flush and face the aileron opening with 1/8-inch-balsa sheet. Fit and glue in the 1/8-inch-ply control-horn mount. Dry-fit the hinges, mount the aileron servo, and keep the control rod short. I use a servo at each aileron (four in all).

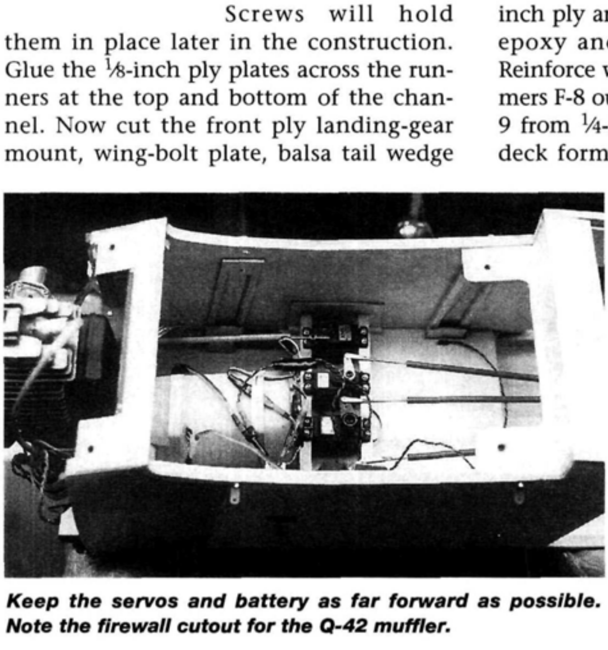
Now finish the lower wing. The center section has balsa blocks at the wing-bolt and wing-dowel areas and it is fully sheeted. Completely finish both wings, as they will be needed to complete the fuselage.

• **Fuselage.** Start by cutting out all the parts needed to make a left and a right side. Mark the inside of the lite-ply sides for the cabane pocket locations. Pin down all the pieces for the right side, then Zap them all together. The left side is built over the right side, so cover all the glue joints with wax paper. The left lite-ply side must be blocked up to be flush with the outside.

With the sides removed from the plan, glue in 1/32-inch-ply gussets where shown. Glue in the 1/4-inch-balsa wing-saddle doubler. At the top of the lite-ply sides, glue in 1/4x3/8-inch spruce filler and 1/8x3/8-inch spruce scarf joints to form the cabane strut pockets. Now, using the plan, cut the ply cabane struts (two front and two rear), and note their angle at the airfoil. Use the struts as a guide to glue in 1/4-inch-square balsa slot runners, being careful not to glue the struts into place; they are removable. Screws will hold them in place later in the construction. Glue the 1/8-inch ply plates across the runners at the top and bottom of the channel. Now cut the front ply landing-gear mount, wing-bolt plate, balsa tail wedge and 1/4x3/8-inch-balsa crosspieces back to former F-4. Pin the crosspieces to the top view of the plan, then place the fuselage sides, (top side down) next to the crosspieces. Pin and block the sides into place. Tape the landing-gear mount and wing plate into place, square up the fuselage, then Zap everything together. Now pull the rear ends of the fuselage together with the balsa wedge in place, and temporarily clamp the tail shut until all crosspieces have been cut, installed and glued.

Remove the fuselage from the plan and glue in all the 1/32-inch ply gussets and the 1/4-inch rear ply landing-gear mounts. At this point, with the fuselage upside-down on the workbench, lay the lower wing in the saddle to check the fit. With the wing in the saddle, use the landing-gear mount as a guide and drill two 3/8-inch holes in the LE for the 3/8-inch wing-hold-down dowels.

Remove the wing and glue 3/8-inch dowels into the holes in the wing, then recheck the wing's alignment with the fuselage. Drill and tap the wing-bolt plate for 1/4-20 mounting bolts. Remove the wing and set aside for now. Cut firewall F-1 out of 1/2-inch ply and install it in the fuselage using epoxy and screws (through the sides). Reinforce with balsa triangle stock. Cut formers F-8 out of 1/8-inch balsa and formers F-9 from 1/4-inch balsa. Glue on all the top-deck formers, glue on the 3/32-inch-balsa sheeting from F-4 forward, and cut out the areas for the cabane-strut pockets. Glue on the 1/4-inch-square stringers from formers F-5 to F-8. Cut out the cockpit, make the headrest from a balsa block, and glue it on. Cut F-C from 1/4-inch ply and glue to the firewall. Cut two 1/64-inch-ply cowl cheeks and glue them into place. Glue hardwood cowl-mounting blocks to F-C, and fit the cowl into place. Trial-fit your engine and try to keep it as short as possible; use a flat plate mount and

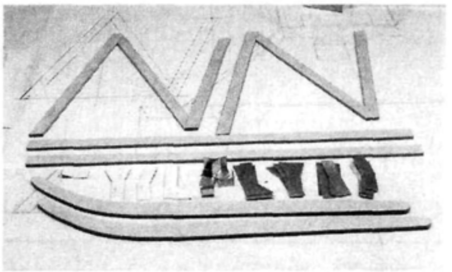


Keep the servos and battery as far forward as possible. Note the firewall cutout for the Q-42 muffler.

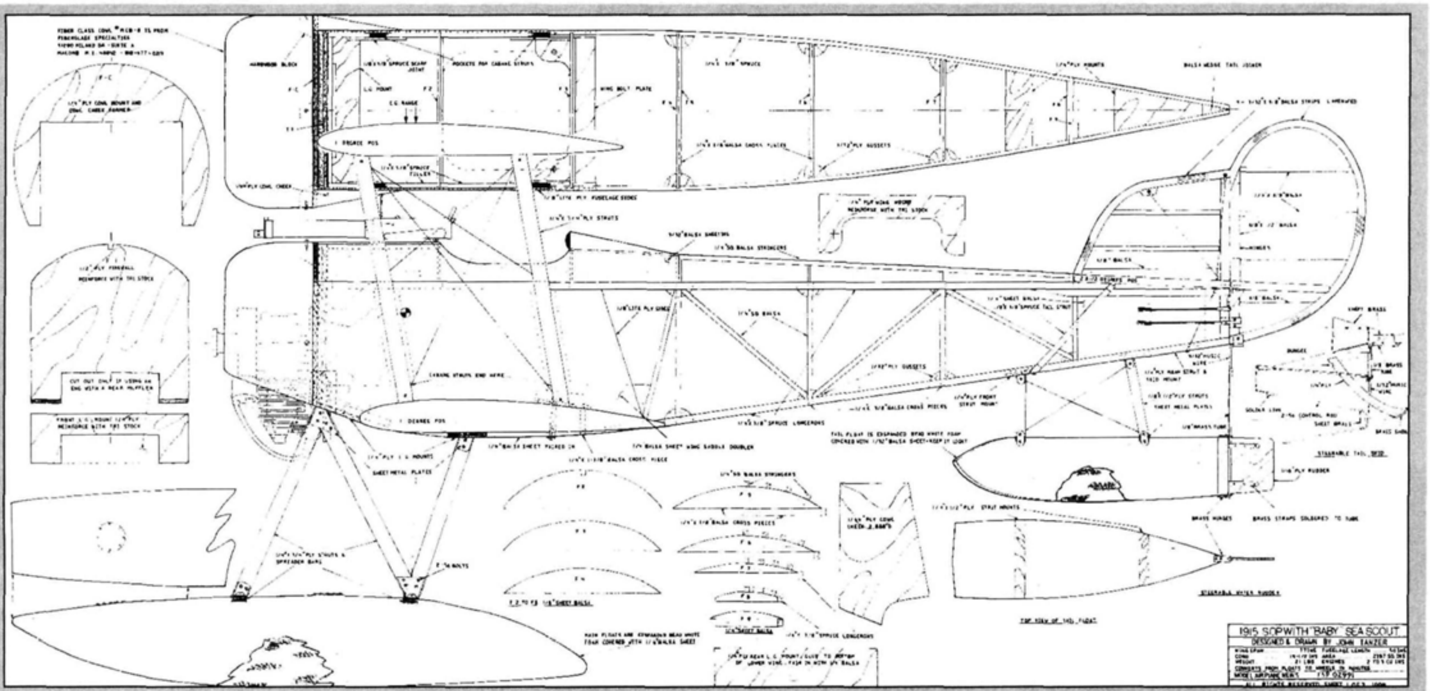
drill a hole in the firewall for the rear shaft. A Q-50 engine works well here.

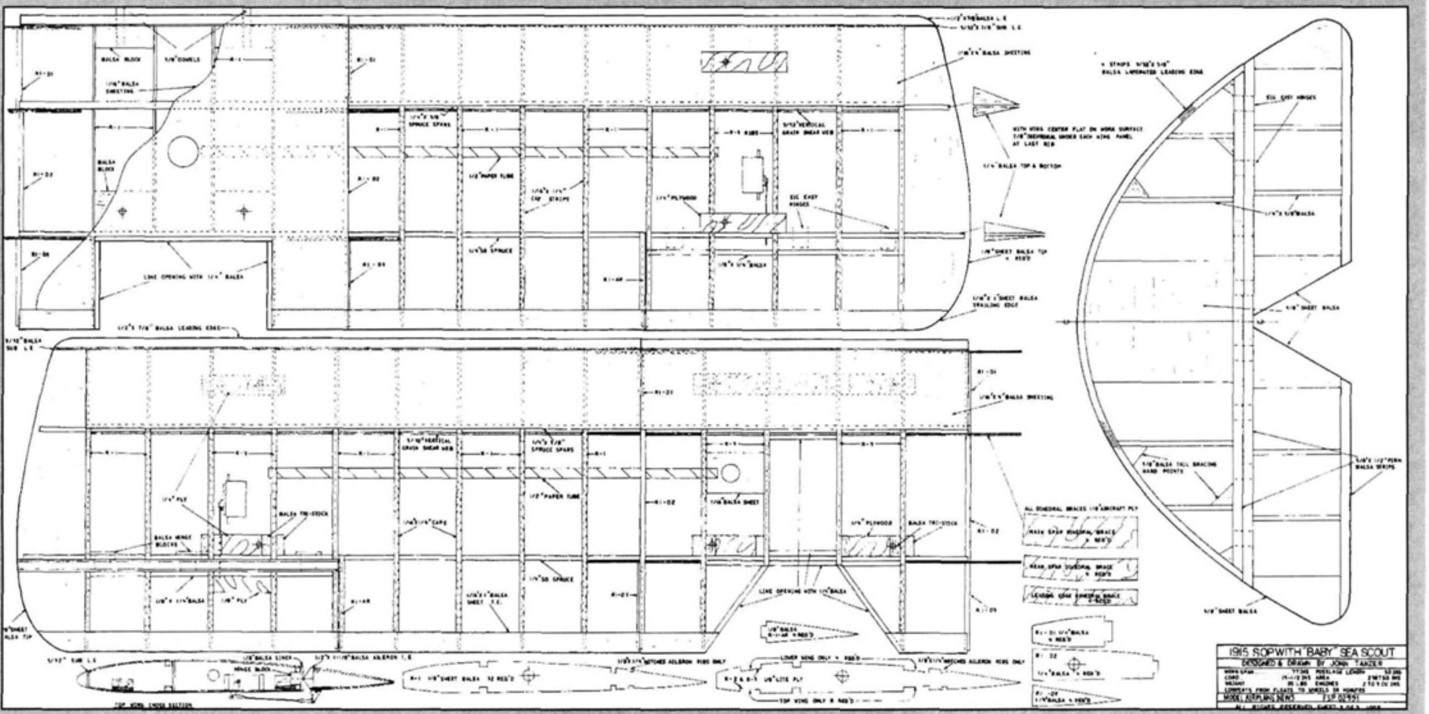
• **Tail feathers.** The rudder and stabilizer outlines are made of four strips of 3⁄32x3⁄8-inch balsa that have been laminated together. Drive pins around the inside line on the plan, soak the balsa strips in water, wipe them dry and glue them together with carpenter's glue. While the glue is still wet, bend the strips around the pins and clamp in place until the glue is dry. Cut the laminated outline to size and fill in the rest of the structure with 3⁄8-inch-balsa pieces. Dry-fit the hinges.

• **Assembly and alignment.** To install the top wing, cut slots at the top of the cabane struts to fit the sheet-metal brackets; epoxy and 2-56 bolts will hold them in place in the struts. Drill a 1⁄4-inch hole in each bracket for the 1⁄4-20 wing bolts. Round off the edges of the struts that extend from the fuselage.



Here are all the parts needed to build the landing gear.





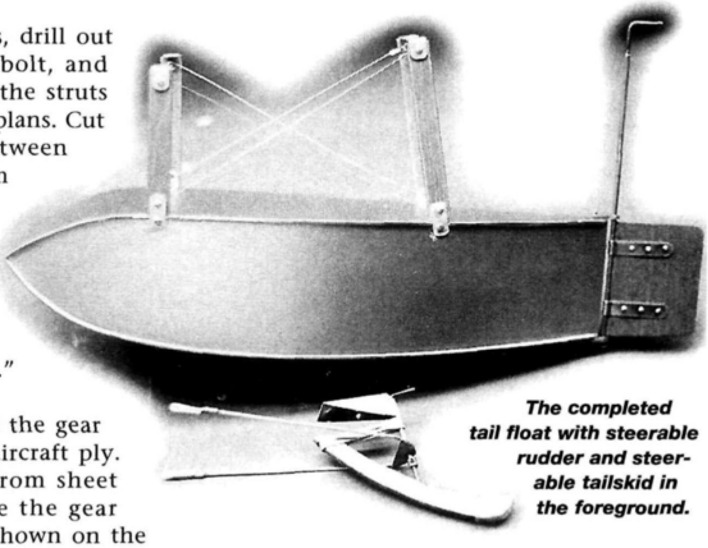
To order the full-size plans, see page 129, or call (800) 537-5847.

FSP02991 SOPWITH BABY

This unusual and very attractive WW I biplane is relatively easy to build and fly. Construction is typical built-up balsa and spruce, and flying wires are not required; the wings are strong enough without them. The cabane struts are wood and removable, so wing alignment and model disassembly isn't complicated. WS: 77 in.; L: 50 in.; engine.: 3.7ci; 4 channels; 3 sheets; LD 3. $19.95

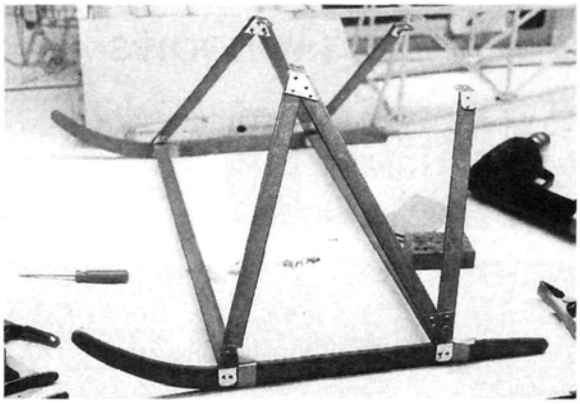
Slide the struts into the fuselage pockets, and drill through the side and into the strut for the sheet-metal screws. Now, lay the wing upside-down on a foam pad, then place the fuselage upside-down on the wing. Mark, drill and tap the wing plates for the mounting bolts. Install the lower wing and check for alignment. Set the plane upright and check the wing incidence, (1 degree positive on both wings). Glue on the stabilizer and the fin. Check the stab for 2½ degrees of positive incidence.

Now make the interplane and mount brackets. Drill and tap the wing plates for the mount bolts, then bolt the brackets to the wing. Cut slots in the ends of the struts and epoxy the struts to the brackets. The cabane and interplane struts are reinforced with 1/16-inch music wire and Du-Bro* solder links. Cut the pin side from the solder links, drill out the hole for a 2-56 bolt, and bolt the links to all the struts where shown on the plans. Cut music wire to fit between links then solder them in place. Wrap the music wire with thin wire and solder where the music wire lengths cross to eliminate metal-to-metal "noise."

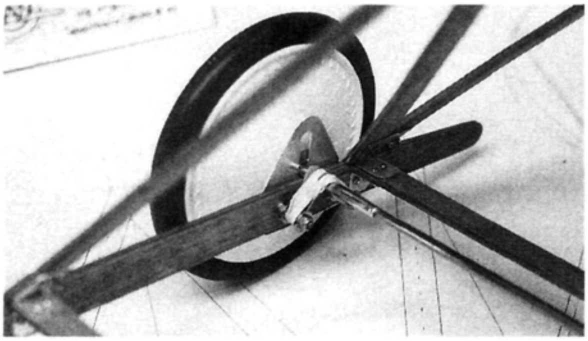


The completed tail float with steerable rudder and steerable tailskid in the foreground.

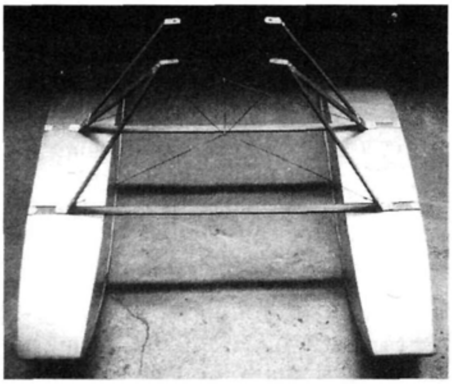
• **Landing gear.** Cut the gear struts from ¼-inch aircraft ply. Make the brackets from sheet metal, and assemble the gear using 2-56 bolts, as shown on the plans. Drill and tap the gear and mount it on the fuselage and the lower wing block with ¼-20 bolts. With the gear installed in the fuselages, square it up, and reinforce it with 1/16-inch music wire and solder links. This is very important; without the wire/links reinforcement, the gear will not survive its first landing.



The completed gear is ready for axle plates and wheels.



This shows the axle and bungee detail.



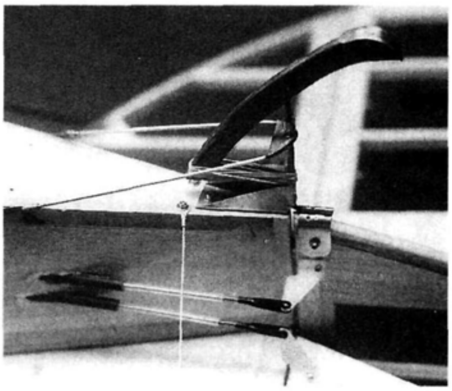
The completed floats and struts showing 1/16-inch music-wire bracing. It is needed on landing gear and float struts.

Install the ¼-inch axle and vintage wheels. Rubber bands are used for shock-absorbing bungees. If you plan to have floats, build another set of landing-gear struts. The removable, steerable tailwheel and tail float are built according to the plan.

The floats are cut from expanded-bead white foam and covered with sheet balsa. The tail-float's wire bracing is control-line cable pulled tightly from bolt to bolt while the float is mounted on the fuselage. I built a lower wing center section to bolt to the fuselage so that I would be able to transport the fuselage with the landing gear attached. Brace the tail with spruce struts and Kevlar cord to keep it light.

To control the Baby, six servos are used—one for the ailerons and two for the elevator (one for each side). One servo is used for the rudder and one for the throttle. Keep all servos and batteries as far forward as possible

• **Covering and finishing.** I covered the top of the aircraft with olive green Coverite* and the underside with buff Coverite, then I brushed on two coats of nitrate dope. The roundels, graphics and the red-and-white checkerboard cowl are cut from 2-mil sign makers' vinyl. The rudder is sprayed with red, white and blue paint. All the wooden struts were stained with Minwax 223 Colonial Maple then coated with Minwax clear satin polyurethane.



Installed on the fuselage, the steerable tailskid helps ground handling and taxi performance.

I installed a 3.7ci Roper engine in place of the original Q-42 because I needed extra weight up front to balance the model. Note the reinforcing wires on the landing-gear struts.

The instrument panel is Arizona Model Aircrafters kit no. AZM-220. A ¼-scale Vickers gun and 7-inch vintage wheels add finishing touches.

I really enjoyed designing, building and flying this ¼-scale WW I aircraft, and I hope you like it enough to build one. Happy landings!

**Addresses are listed alphabetically in the Index of Manufacturers on page 134.*

MODEL AIRPLANE NEWS
HOW TO

Aircraft like this Ikon N'West L-19 Bird Dog have a lot of "glass." The windshield and back window are often difficult to fit properly into place, but this technique should make it easier for you to install them.*

Install a FORMED WINDSHIELD

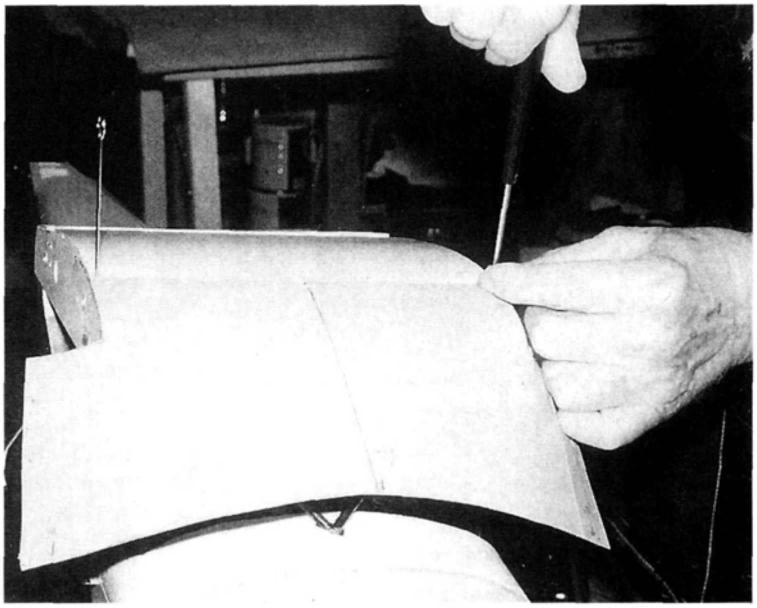
Take the pain out of making windows

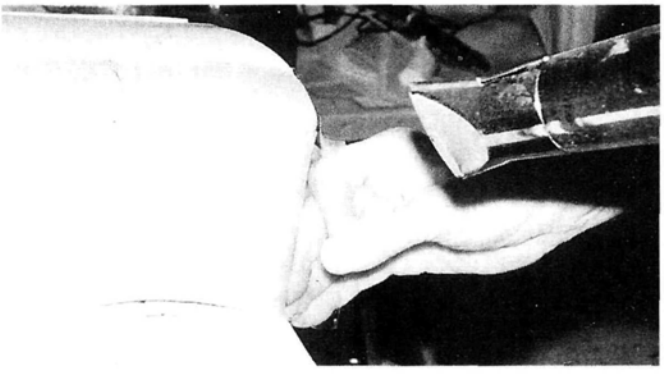
by Myron Pickard

I have always had trouble shaping plastic windshields over open areas on models. Using a heat gun helps, but if you aren't careful, the plastic can easily be distorted. I decided there had to be a better way, and there is! Here's what I came up with.

1 Use cardboard (here, part of a cereal box) to make a template for the front windshield.

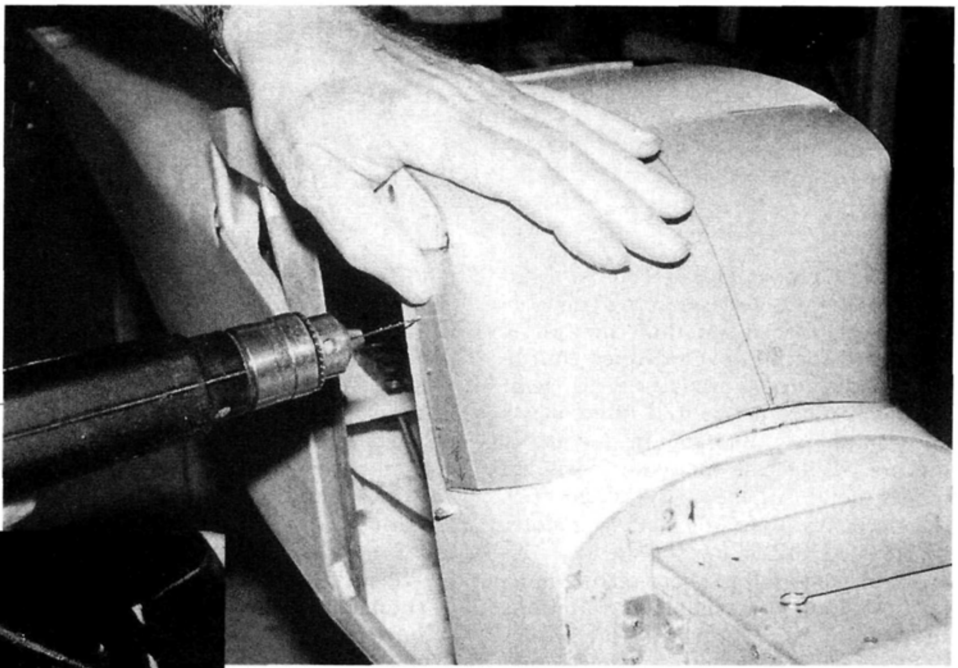
2 When you're satisfied with the template's shape, use it to trace the windshield's outline on clear plastic, and then cut the plastic to shape. Be careful to cut the inner corners smooth and round, or the plastic will crack there. With that done, screw the template into place on the model, so it will support the plastic when you use a heat gun to form the windshield.

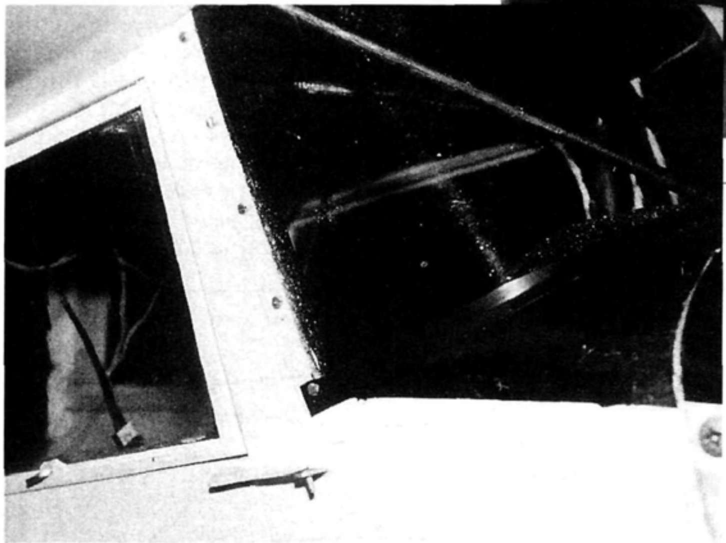




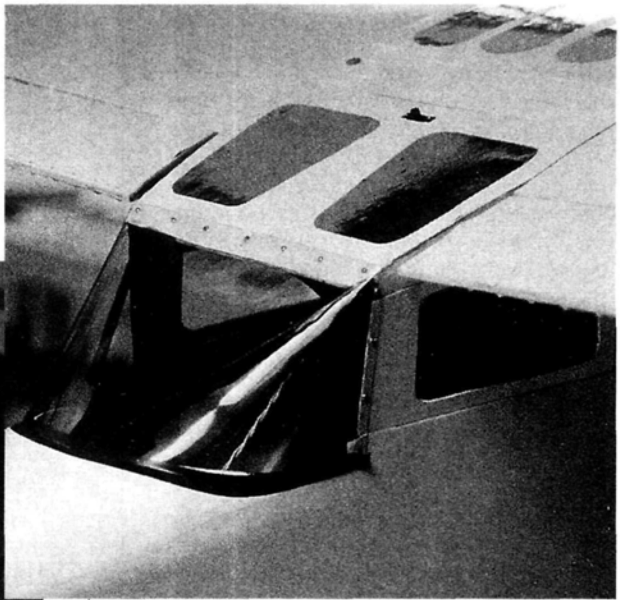
3 Remove the screws holding the top edge of the template, place the windshield material on top of the template, and then re-install the screws through the plastic and the template. (I used 0-1/4 pan-head sheet-metal screws from Micro Fasteners* spaced at 1-inch intervals.) Now use the heat gun to heat the windshield along its top radius while you gently pull it into position. Do not use too much heat or the plastic will blister.

4 When the windshield has been pulled into its proper position, heat along one side while also pulling that side into position, and then secure it with a couple of screws. Repeat the process for the other side. When the plastic has cooled, finish drilling the attachment screw holes (again, 1 inch apart). Having done this, remove the windshield and the template.

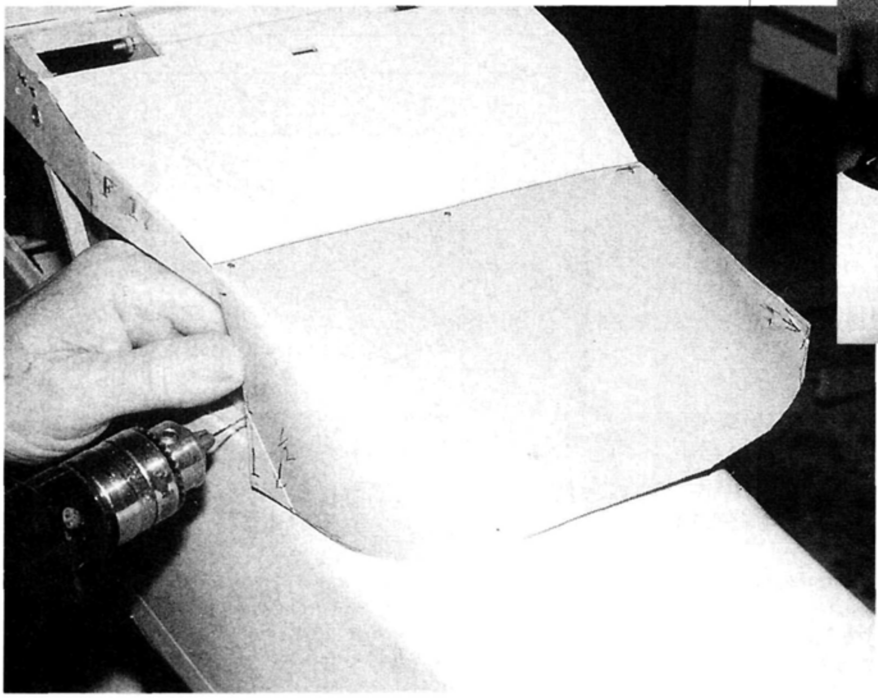




5 Clean the windshield and then screw it back into position. Hold the bottom edge in place with a strip of electrical tape cut in half lengthwise. Using tape here makes it easier to remove the windshield for repairs and maintenance. For an even more authentic scale appearance, you can glue the windshield into place and add plastic-frame strips to the sides.



6 Make the L-19's rear window in the same way. It might be a good idea to save these templates in case you ever need to replace a broken or cracked windshield or window.



7 Here's the finished rear window. Again, I used electrical tape to hold the lower edge in place.

If, like me, you've had grief making and installing clear plastic windshields on your models, give this technique a try. I think you'll like the results.

**Addresses are listed alphabetically in the Index of Manufacturers on page 134.*

EFFECTIVE PROGRAMMING *by Don Edberg*

Mixing for Flaps

In the October and December 1998 columns, we discussed programmable mixers; special functions that allow you to specify how a defined control input automatically produces a change in a second, unrelated control function. As an example, we used aileron —> rudder mixing, which automatically produces rudder motion whenever the aileron stick is moved. It's useful for making smooth, coordinated turns at low speeds.

So far, we've talked about mixing functions as applied to centering functions such as ailerons, elevator and rudder (when I say self-centering, I mean that when you let go of the control stick, it returns to the center position; so center is the neutral position). But there is no reason that we cannot use mixers with non-centering functions such as throttle or flaps. This month, we'll discuss some interesting applications of programmable mixing to models with flaps.

MIXING FOR FLAPS

These days, many airplanes have flaps (flaps are movable surfaces inboard of the ailerons, and often—but not always—only drop downward). Scale jobs have flaps if their full-size counterparts do; ducted fans have flaps for better takeoffs and steeper, more predictable descents. Fun-fly ships may have flaps for enhanced maneuverability, and gliders use flaps and ailerons to increase launch and cruise performance. Computer radios allow you to take maximum advantage of flaps in all of these cases.

Most computer radios today have sticks for the four primary controls (aileron, elevator, rudder and throttle), a toggle switch for retractable landing gear, and either sliders or rotary knobs for "auxiliary" controls, which are used for flaps or spoilers. The knobs turn a little too easily; they are difficult to position precisely, and this makes it difficult to command the desired amount of flaps. I receive many questions about a relatively straightforward topic: "How can I program my radio so that when I flip a switch, the flaps drop a certain amount?"

We'll assume that the transmitter for which we want "switched flaps" does not have the capability to assign the control directly to a switch, so we'll use the next best thing: a programmable mixer. There are several ways to accomplish this mixing, depending on whether you want to have the flap motion fixed in your transmitter's memory or you want to be able to adjust it "on the fly." You'll do the latter with one of the nuisance knobs! Available flap programs are listed in Table 1.

Let's talk about the fixed-flap motion first. If you have a simple 5-, 6-, or 7-channel radio, you can use the only switched control—gear—to be the master control. This means that you'll probably want to set things up so that when the gear is down, the flaps are down; when the gear is retracted, the flaps are up. This would be configured as follows.

Since you want the control that is commanding the flaps to be the gear switch, you select MASTER = GEAR. The slave channel (the one the flap servo is plugged into) is identified as: SLAVE = FLAP. You must set up the mixing percentages so when the gear switch in the "up" position, there is no flap deflection, and when the gear switch is in the "down" position, the flaps are dropped to your desired degrees of travel. This is shown in Figure 1.

The more primitive, less expensive computer radios mix from the center of the master control, as illustrated in the sketch on the left side of Figure 2. In this case, it's sort of in between gear "up" and gear "down." If you have a more expensive radio, it will allow you to offset the mixing curve, an idea that we discussed last time. You'll now see a good reason to do it.

If your radio allows you to offset the mixing point, then you can offset it to start mixing at the "up" position, so that only the "down" mixing percentage will affect the flap motion. And, as you can see on the

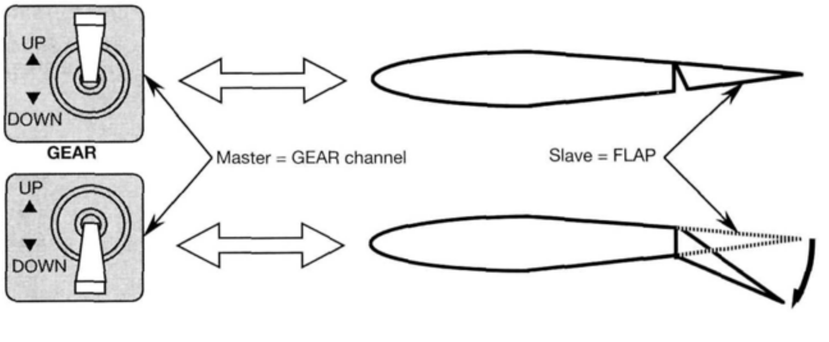


Figure 1. By setting Master = Gear switch and Slave = Flap channel, we get switch-controlled flaps—flaps that drop by flipping a switch! No more fooling with twisting knobs.

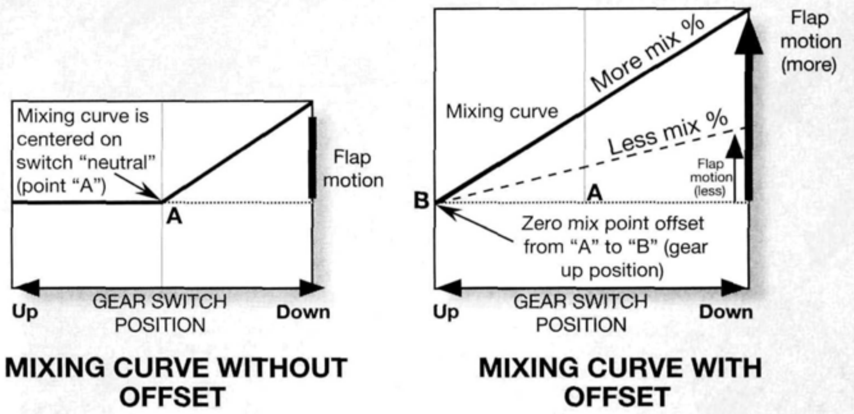


Figure 2. The system's mixing curves determine the amount of flap travel when you flip the retract switch. If your radio allows you to offset the mixing curve (not all do), you can get more travel as shown by the height of the large arrow on the right of the right sketch. Adjusting the mixing curve percentage controls the flap motion.

TYPE OF FLAP MIXING	RESULT
None (flap knob or slide movement controls flap position).	• Hard to get specific amount of flap motion without taking eyes off model and looking. • Zero flap motion tricky unless defined at one end of knob/slider motion.
Program Mixer with Master = Knob channel, Slave = Flap.	• Can turn off flap motion entirely. • Can adjust flap motion when mixer is on (only good for determining desired flap motion).
Program Mixer with Master = Gear (or other switched channel), Slave = Flap.	• Can command exact flap position by flipping a switch.
"Flap 2" (on Airtronics Stylus); "OFS mixing" (on Futaba 8U and 9Z); "Flap System" (on JR 10SxII).	• *Built-in function provides switchable flap settings.* (Stylus provides one position; 8U and 9Z provide up to five; 10SxII provides two.)
Program Mixer with Master = Gear (or other switched channel), Slave = Flap.	• Can command exact flap position by flipping a switch.
"Flap 2" (on Airtronics Stylus); "OFS mixing" (on Futaba 8U and 9Z); "Flap System" (on JR 10SxII).	• Built-in function provides switchable flap settings. (Stylus provides one position; 8U and 9Z provide up to five; 10SxII provides two.)

right side of Figure 2, by offsetting the mixing point from A to B, you can get greater flap travel because the mixer has twice the master control movement (the separation between "up" and "down" switch positions) to command the slave motion. Note that both mixing curves in Figure 2 have the same slope, but the one on the right commands more slave travel since it starts all the way on the left side of the box.

By examining the sketch on the right of Figure 2, you can see that one way to adjust the flap motion is to change the mixer percentage. This changes the slope of the mixing curve. The higher the percentage, the "steeper" the slope, and the more flap travel you get. The dashed line marked "Less mix %" and small arrow show the amount of flap motion when the mixing percentage (the slope) is reduced.

SETTING THE RIGHT AMOUNT OF FLAP TRAVEL

Now that you know how to set up switch-dropped flaps, the next question is, "Just how much flap travel should I have?" Obviously, this will depend on what kind of airplane you have and what you're trying to do with the flaps. One way to experiment is to set the percentage that looks right and go flying. If you're trying to achieve a steeper descent, you can change the mix percentage to get the right amount of flaps by trial and error. But there's an easier way that involves using a knob or lever as the master channel.

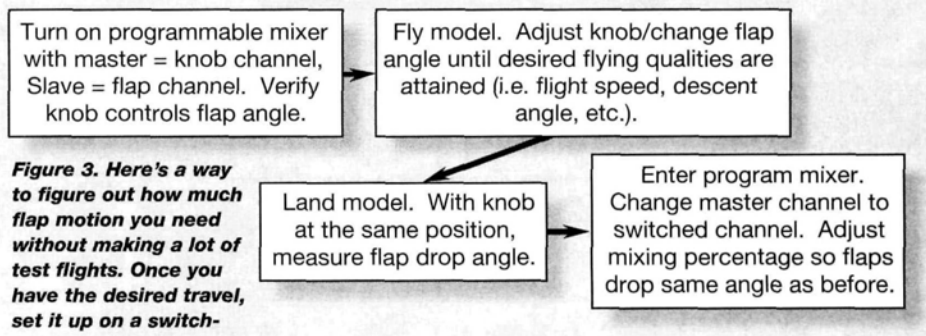
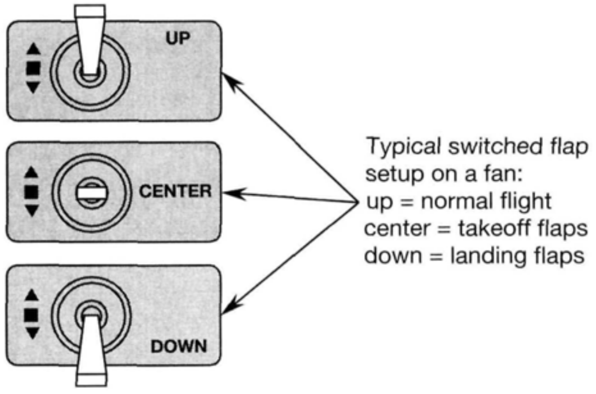


Figure 3. Here's a way to figure out how much flap motion you need without making a lot of test flights. Once you have the desired travel, set it up on a switch-controlled channel.

We'll use a programmable mixer as we did before, but this time we'll choose the master channel to be some control that's changed with a knob or slide lever. Set the mixing value to be 100 percent so the master control has good authority over the flaps (reduce it from 100 percent if you think it may be *too* sensitive). Then, while the plane is actually flying, you can experiment with the drooped flap position by turning the knob or sliding the slide lever until the model flies the way you want. After landing, note the amount of flap travel that you've arrived at, and either use a precision ruler or a digital pulse width meter to measure the amount of flaps. Then go back to the mixing menu, change the master channel to the gear (or other switch) and set the mixing percentage to match the amount of travel you just arrived at while flying. This procedure is displayed in Figure 3.

Figure 4. If your system has assignable mixing or a special flap system, you can assign several flap settings to a three-position switch for convenience.



ANOTHER WAY TO GET SWITCHABLE FLAPS

We've learned a couple of ways to get switchable flaps. If you happen to have a Futaba* 8U or 9Z, there's an even better way to do it. It's called "offset mixing." Offset mixing is accomplished by going to a program mixer as before, but instead of choosing a switched channel as the master, you select an option called OFS, for "offset." The slave is still the channel that the flap servo is plugged into. Note that this offset has a different meaning than the offset value for the mixing curve as shown in Figure 2.

Operation of this type of mixing is simple. All offset mixing does is command a fixed offset, or bias, in the servo that is the slave. It's very similar to a Snap Roll switch, except you can assign motion to any channel. (The name "offset mixing" is somewhat of a misnomer because there is no real mixing occurring. It's kept in the mixing menu since it's very similar to a regular mixer.) What's nice about the mixers on these radios is that you can assign the switch that activates them to nearly any switch on the radio, and you can also select the direction that turns it on and off!

Depending on the number of free programmable mixers available, you can set up several so that you have a variety of flap positions from which to choose. Owners of 8U and 9Z typically assign the two flap settings to a three-position switch so they can select any of the three with a single switch: the top position is "clean" for normal flying, the middle position is used for takeoff flaps, and the switch's down position is for landing flap. This set of preset flaps may be used in addition to airbrake mixing, which we discussed in a previous column.

JR's* 10SxII (airplane version only) features a built-in "Flap System" to achieve this function; the Airtronics* Stylus has "Flap 2" to command one switchable position. On other radios, you can simulate the switchable offset function by mixing the gear channel to itself and adjusting the mix percentage to get the amount of travel you want. This won't work, however, if you have retracts in the gear channel. In that case, you'll have to mix an auxiliary channel into itself, and be careful not to move its knob or slide lever. Next time, I'll show you how to disable a knob so you don't need to worry about bumping it.

COMMENTS ON A PREVIOUS COLUMN

R.W. Fentiman of Perth, Ontario, Canada, sent me a note saying, "Your articles in *Model Airplane News* are always interesting, and usually I learn something new, but I was surprised to read in your column in the October '98 issue that the Airtronics Radiant does not provide any mixers.

"Mine has the following programming features: Aileron —> Rudder, Throttle —> Elevator, Elevator —> Flap, Flap —> Elevator, as well as Flaperon, Spoileron/Crow, Aileron Differential, Elevon and V-Tail."

Of course this is true; however, what I thought I was saying is that the Radiant has no freely programmable mixers. Certainly it does contain the pre-programmed mixing functions listed above. I apologize if this statement misled anyone.

Remember, if you want to write me, send an SASE to 4922-C Rochelle Ave., Irvine, CA 92604, or email me at dynamic3@flash.net. I get lots of mail, so please be patient! Sources for more in-depth material on this column's contents may be found at www.flash.net/~dynamic3/.

**Addresses are listed alphabetically in the Index of Manufacturers on page 134.*

Tools of the Trade

In my last column, I discussed different size helis as well as various gyros and radios. Let's look some more at why heli radios are better than airplane radios for controlling our helicopters.

To fly most airplanes, you need four channels or functions—ailerons, elevator, rudder and throttle. For an average helicopter—assuming it has collective pitch—you need five channels: roll cyclic (ailerons), pitch cyclic (elevator), tail rotor (rudder), collective (main-rotor pitch) and throttle. To make things easier, let's refer to all heli control functions using fixed-wing terminology: aileron, elevator and rudder. Most gyros now have switchable dual rates; therefore, a heli radio requires a sixth channel for this function.

As far as controlling the model is concerned, heli and airplane radios are set up in the same way: aileron is for roll, elevator is for pitch, and rudder is for yaw. The difference between the two types of radio lies in throttle and collective-pitch control; heli radios mix these two functions electronically. As you increase or decrease collective pitch, the radio increases or decreases throttle for you.

Heli radios can also compensate for torque. With helicopters, torque is produced by the engine to turn the main rotor; depending on the direction of main-rotor rotation, the body of the heli will try to rotate in the opposite direction. This is why tail rotors exist: to counter the effects of main-rotor torque.

It works like this: the heli is set up to hover with the collective/throttle stick at its midpoint of travel on the transmitter. The heli will hover with, say, 5 degrees of main-rotor pitch. To counter the main-rotor torque, the tail rotor will need a certain amount of pitch, and this is initially set mechanically. Now, if you increase the collective pitch/throttle to climb, torque forces increase, and the heli body rotates in the opposite direction to the main rotor. Increased tail-rotor pitch is now needed to prevent the body from moving.

The opposite happens when you decrease collective pitch/throttle. A heli radio can be set up to automatically increase or decrease tail-rotor pitch to compensate for the torque changes. This function is known as ATS, or revolution mixing.

Features such as servo-reversing, dual rates, exponential and ATV are usually found on both types of radio, and they all work in much the same way.

KNOBS AND SWITCHES

If you have ever looked at a heli radio, I'm sure you've noticed that it has more knobs and switches than an airplane radio. These additions are for idle-up, throttle-hold and various engine and hover pitch adjustments. The idle-up switch allows the heli pilot to do aerobatics by placing the throttle in a predetermined curve that works with collective pitch. Throttle hold is for practicing autorotations (more on this in a future column).

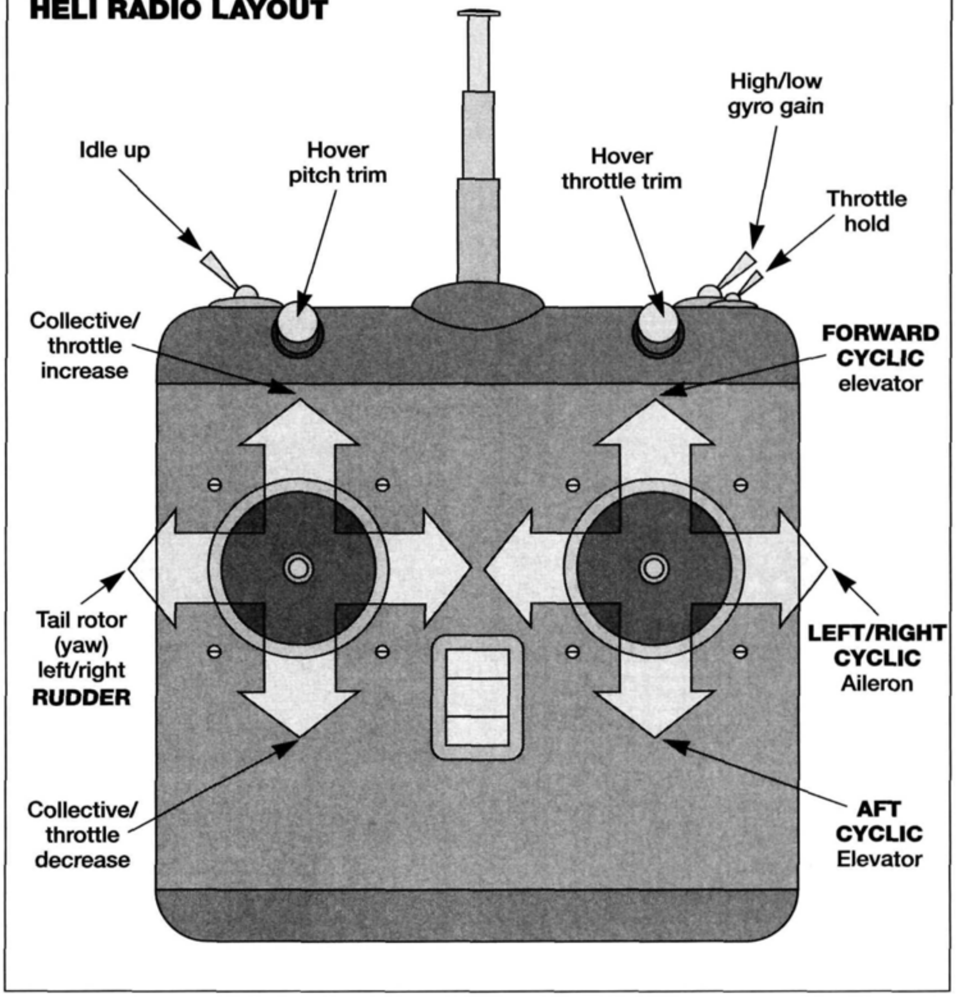
The knobs allow small changes to be made to the hovering pitch and hovering throttle without having to go into the radio's program menu. These adjustments are for normal day-to-day tweaks to compensate for air temperature, humidity and other factors that affect your engine's performance.

The idle-up switch allows you to select different pitch and throttle settings (curves) so you can do aerobatics. If you have ever wondered how inverted hovering is possible, idle-up is the answer. In a normal setup, as collective pitch is decreased, so is the throttle. With idle-up, whether pitch is increased or decreased, the throttle is increased to maintain main rotor rpm.

The throttle-hold switch electronically uncouples the throttle and collective pitch so autorotations can be performed. When throttle-hold is activated, the engine goes to a low idle setting, the clutch disengages, and you control only the collective pitch. Autorotations are great fun to do; they are also the *last* maneuvers contest pilots do. If you're able to do autorotations, you can also save your heli from crashing if the engine quits in flight.

This has been a simple explanation of heli radio systems; I'll continue the discussion during the coming months. For more heli-radio info, also refer to Don Edberg's "Effective Programming" column in the June '98 issue.

HELI RADIO LAYOUT

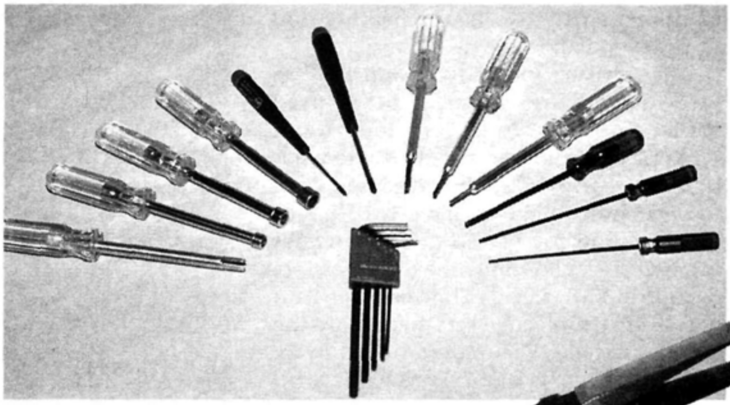


TOOL TIME

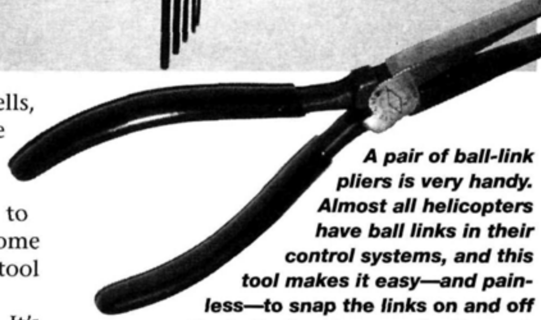
Someone once said that if you build a crooked foundation, the best you can hope for is a crooked house. The same applies to helicopters. You need good tools and the know-how to use them to build a helicopter correctly. While certain tools are absolutely necessary, others just make building your heli easier.

Helicopters have many rotating parts that should be balanced for smooth running. A Robart* High Point balancer is the most popular balancer used, but I'm sure other brands will work as well. The important thing is to get one and use it. "What gets balanced?" you ask; rotor heads, tail rotors, clutch bells, main gears and cooling fans are the usual parts. While it may sound like a lot of stuff to balance, it takes only a few minutes with each to achieve good results. A balancer of some sort is probably the most important tool of all.

A dial indicator is next on the list. It's used to check the "run-out" (out-of-true condition) of the clutch assembly. On some helis, the starter shaft also needs to be true. Because these parts are turning at engine rpm, you want them to run as true as possible. Run-out of more than 0.002 inch is unacceptable. The vibration caused by these out-of-true parts will beat bearings to death very quickly and also cause other parts to wear out prematurely. The heli will shake visibly to let you know something is not right. The radio



Basic tools for R/C helis: a set of hex wrenches and ball-end Allen wrenches, Phillip-head screwdrivers, nut drivers and a ball-link driver.



A pair of ball-link pliers is very handy. Almost all helicopters have ball links in their control systems, and this tool makes it easy—and painless—to snap the links on and off the balls (really saves the fingers).

A balancer—this is the Robart High Point unit—is one of the most important heli tools. Balanced parts are less likely to cause vibration, and this lengthens the life of your equipment.

WHAT'S IN A NAME?

All disciplines have their own their own "languages"—special words and terms; this is particularly true of helicopter flying.

- **Autorotation.** This happens when the helicopter engine is either at a low idle or is completely off and the helicopter is, in effect, gliding (much like a dead-stick landing).
- **ATS, or revolution mixing.** This is where the radio "mixes" (adds or subtracts) tail-rotor pitch to compensate for engine-torque changes.
- **ATV.** Servo-travel endpoint adjustments; works in the same way as on our fixed-wing brothers.
- **Blade grips.** Mounting points for the main rotor blades.
- **Collective pitch.** Both main rotor blades increase or decrease angle of attack by the same amount at the same time. This allows the helicopter to rise and descend.
- **Cyclic pitch.** This is where one blade increases its angle of attack and the other blade decreases its angle of attack during its rotation. This provides directional control—left, right, forward and backward.
- **Clutch.** A round disk with two slots cut into it to allow the clutch shoes to expand and seat in the clutch bell and thereby drive the pinion gear. Allows the engine to idle without turning the main rotor.
- **Clutch bell.** A housing with a fiber liner on the inside diameter for the clutch to engage. Pinion gear is also attached to the clutch bell.
- **Constant tail drive, or driven tail.** The main rotor drives the tail rotor during autorotations, even when the clutch has been disengaged; mostly used for contest flying in which the ability to steer the heli during autorotation is needed.
- **Curves.** The "shapes" of the pitch- and throttle-servo movements. Most computer radios have a five-point pitch and throttle curve (some radios have more points). In effect, you tell the servos how much and at what point to move.
- **Flybar.** A metal rod with a paddle on both ends that is part of the rotor control system; provides stability and control.
- **Hold, or engine-hold, switch.** When engaged, this kills the engine or brings it to a low idle to disengage the clutch so that autorotations can be performed.
- **Idle-up.** When engaged, this function keeps engine rpm up when the collective/throttle stick is lowered. How much throttle is determined by the curves and allows the rotor speed to remain high to perform aerobatics.
- **Main blades.** The heli's main lifting surfaces.
- **Main frame.** The heli's main chassis; everything is built around this.
- **Main gear.** Gear that is driven by the pinion gear attached to the clutch bell, which is driven by the clutch. The main gear drives the main rotor and the tail rotor.
- **Main shaft.** Supports the rotor head and is driven by the main gear.
- **Rotor head.** What the main-rotor blade grips are attached to; is also the central piece of the collective-pitch and cyclic-pitch control system.
- **Seesaw unit.** A carrier for the flybar.
- **Swashplate.** A device that converts linear motion into rotary motion. It is fitted to the main shaft and controls the main rotor (pitch changes).
- **Tail boom.** Tube that's attached to the main frame and supports the tail-rotor gearbox and the drive system for the tail rotor; usually made from aluminum or carbon fiber.
- **Tail-boom supports.** Aluminum or carbon-fiber rods that are attached to the main frame and the tail boom.
- **Tail-pitch slider.** Similar to the swashplate; controls the tail-rotor pitch.
- **Washout unit.** Has sliding arms and is attached to the main shaft; it controls the flybar paddle's angle of attack.

equipment will also take a beating and might even fail.

Allen drivers, nut drivers and Phillips screwdrivers are the most often used tools, and all R/C shops sell them. Though you can use the Allen wrenches that come with some kits, they do tend to wear out quickly. I have two sets of drivers—one for my shop and one for my field box. Bondhus makes a neat set of metric ball drivers that can get into hard-to-reach places—very handy! By the way, we're talking about metric hardware here. Also very handy are 7mm and 5.5mm open-end wrenches. (I bought mine at Sears.)

To get the servo movement to the various bellcranks, most helis use a lot of ball links; again, one of the must-have tools is a ball-link pliers. It makes snapping the links onto and off the balls very easy, and it doesn't scratch the ball or damage the link. Your local R/C shop should offer various ball-link pliers.

How do you get the links onto the pushrods?—by using a tool designed to screw the links on. Hobbico* makes a neat little tool to screw ball links onto pushrods—sure does save wear and tear on the fingers. This is not a complete list of useful heli tools, but they are the ones that you'll use the most.

Next time, I'll begin a build-along project featuring Hirobo's Shuttle RG—a metal-frame machine that's typical of modern heli designs and will serve to show building techniques you can use on other helis.

Next time out, I'll begin a build-along project featuring the .32-size Hirobo* Shuttle RG heli to show general building techniques that can be applied to almost any helicopter because the Shuttle RG is typical of today's helicopter designs.

If there is anything you would like to see discussed in this column, let me know. If you write to me c/o *Model Airplane News* and would like a reply, please enclose an SASE.

Until next time, fly safely and have fun!

Correction: in my first column, the email address given was incorrect; my address is rbell02@snet.net.

**Addresses are listed alphabetically in the Index of Manufacturers on page 134.*

Readers Write About CAD

Over the last few months, I've received a number of questions from readers who have run into various problems with their CAD programs. Of course, the problem with trying to troubleshoot these issues is that there are so many CAD systems on the market, and some of those being used are not really up to the task of designing model airplanes. But since some of these issues are pertinent to all CAD systems, I'd like to address a few of them here.

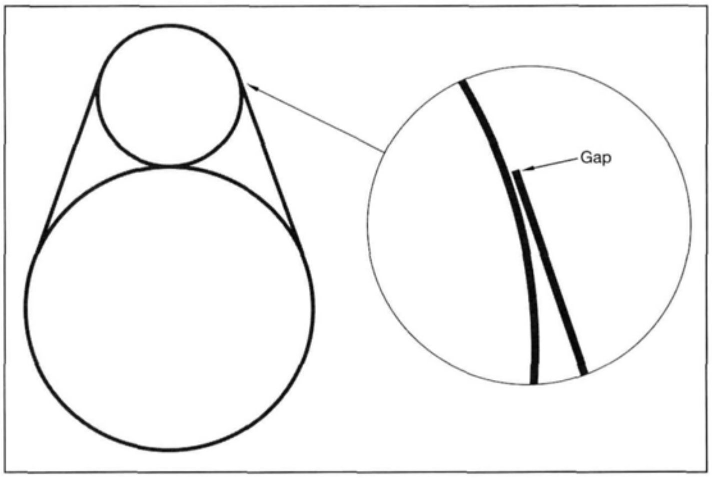


Figure 1. One potential problem with using a tangent line or arc to trim a circle or ellipse is that the line might not intersect properly. This drawing shows how a line that appears to be tangent to the circle might, if zoomed in very close, turn out to miss intersecting by a tiny fraction of an inch.

CAD DRAWING GLITCHES

Why does CAD sometimes leave a gap between two entities when I try to snap to an intersection or draw a line tangent to two circles? The entities fail to meet by a tiny bit (maybe a millionth of an inch), and when I try to use one entity to trim the other, the computer tells me there's no intersection.

Bear in mind that to CAD (and the computer), all the entities you're drawing on the screen are mathematical computations—not physical lines, arcs and ellipses. Most of the time, this works just fine, and it's because of this that we're able to do useful things like scale the drawing to any size, use it as a basis for laser-cutting files, and cut and paste entities over and over without losing resolution. *But*, there's a price to pay. Most of the time, the mathematical computations that describe the entities are fairly simple, but in some cases, they can become pretty large (such as when calculating the point of tangency on an ellipse). Once in a while, the inevitable rounding error will result in two entities not quite meeting the way they're supposed to.

This quirk is most common when trying to draw a line or arc segment tangent to two circles (such as when lofting former sections). The line won't be able to trim the circles, leaving you apparently stuck (Figure 1). But this isn't as big a problem as it might seem. Whenever this happens to me, I just draw a temporary trimming line from the end of the line to the center of the circle and use that to trim the circle (Figure 2). Then I erase one of the two entities and redraw it relative to the endpoint of the other entity. Now all the endpoints meet, and you can go on with business as usual, editing the group of entities into a closed polyline, offsetting for the skin thickness and adding stringers, turtledeck, etc. (Figure 3).

MORE 3-VIEW IMPORTING QUESTIONS

Is there any other format in which to scan model airplane plans besides DXF that AutoCAD LT can read?

Actually, few scanners have the level of sophistication to create a really good vector drawing directly from the scan (there are some that are this "smart," but they're usually far too expensive for hobby use). For this reason, we normally save the scanned image as a PCX file, which can then be converted into a DXF file using a PCX to DXF converter utility (several of these are available for downloading from the Internet). This rather cluttered file can then be imported into your CAD program, where you trace over it on a second layer with lines, arc segments, etc., before erasing it. For more on this process, refer to

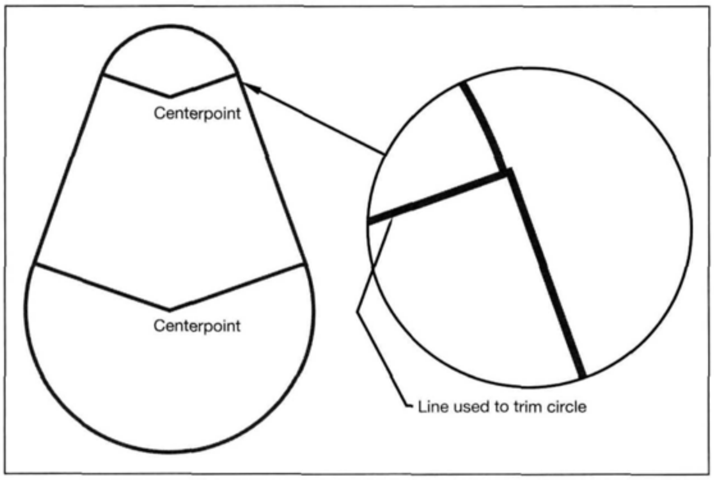


Figure 2. In cases where a tangent line doesn't intersect properly, you can draw another line from the endpoint of the tangent line to the centerpoint of the circle and use that to do the trimming. Then you need to erase and redraw the line so that the endpoints will match up correctly.

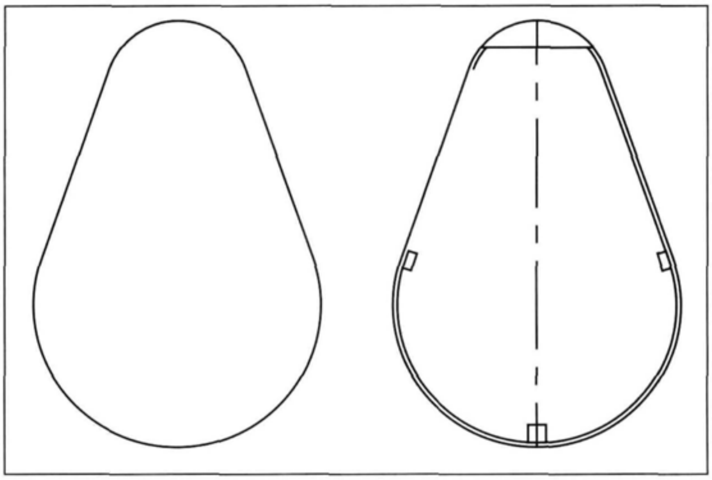


Figure 3. Once you have the circles or ellipses trimmed, you can erase and redraw the lines so that they meet properly and then continue with designing the former by offsetting for the skin thickness, adding stringer slots, etc.

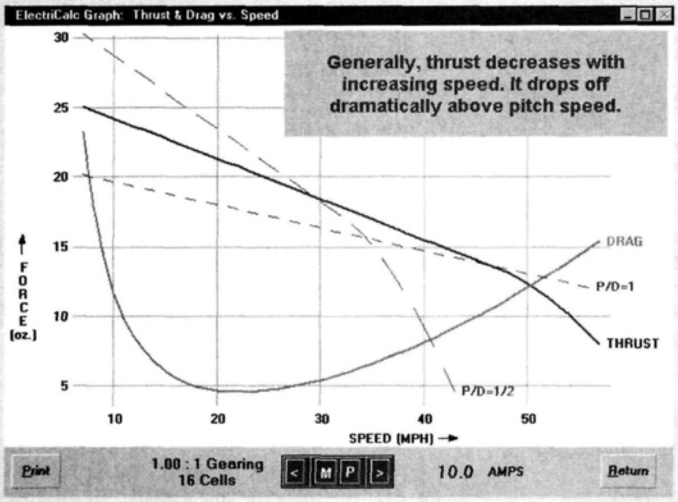
"Cybernews" in the August 1997 issue of *Model Airplane News*.

The other image import format supported by AutoCAD and many other CAD programs is WMF (Windows Metafile). While it doesn't include all the block, font and other formatting information contained in a native CAD file, WMF files *do* contain vector information (as opposed to being raster images), so they can be scaled to any size without losing resolution. Metafiles are handy because, as a standard Windows format, they can also be moved back and forth between various Windows utilities. Of course, the rub is still one of getting a scanned 3-view into a vector file format, be it DXF, WMF, or whatever.

Finally, note that some CAD systems allow importing, or at least displaying as a transparent layer, various other file formats. For instance, Ashlar DrawingBoard*, in addition to allowing imports of DXF, WMF and DWG files, also allows the use of bitmap (BMP) files, so you can use a scanned raster image without even converting it. This is one more very nice feature of this excellent, low-cost CAD system. For

ELECTRIC FLIGHT PREDICTION PROGRAM UPGRADES

I'm pleased to report that two outstanding flight performance prediction programs for electric models just got better. First, SLK Electronics'* "ElectriCalc" has just been released in version 2.0. Those familiar with this handy program will recognize the simple main display of version 1.0 that makes this program so easy to use. But the developer, Sid Kauffman, has added some great improvements that increase the value of the application. First of all, the databases that come with the program have been greatly expanded.



Among the features of the newly revised ElectriCalc 2.0 is a truly outstanding tutorial. Here, one of the new graphs is demonstrated by an animated cursor and explanatory captions. The tutorial even explains the significance of the data being presented.

Also, a sort utility has been added so that the databases can be sorted into any order you prefer. Operation of the program has been further simplified by the addition of buttons to access the databases and several "auto-entry" features. But info-junkies will like ElectriCalc even more because it adds a number of features for graphically reporting data like prop options, system efficiency and thrust versus drag curves.

Possibly the handiest new ElectriCalc feature is the "analyzer." This powerful tool is capable of evaluating literally thousands of possible combinations of cells, props and gear ratios. You can set the step increments and range of options to be evaluated, and you can even set limits for maximum current and motor rpm. Last, to save you from having to read through the blizzard of data that comes from such a study, ElectriCalc can sort and filter the results to display only the most promising combinations.

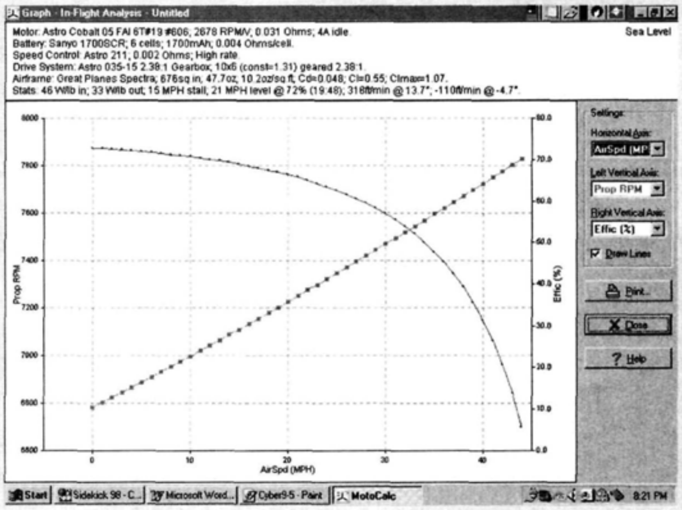
ElectriCalc is available direct from SLK Electronics or from most electric flight mail-order suppliers. Visit its website at http://www.slkelectronics.com/ to learn more.

The other newly improved electric flight prediction program is Capable Computing's* "MotoCalc," now available in version 5.0. Among the useful features included in this new version is the capability of providing estimates for electric ducted-fan models; by filling in data to describe the fan unit and the inlet/efflux ducting, the program gains a working understanding of the layout (and probable efficiency) of the proposed system. Needless to say, the program does not differentiate between straight and bifurcated inlets/tailpipes and the like, but this is a big step forward in predicting ducted-fan performance, and as anyone who's tried to design one knows, few airplanes are more critical on the *"Will it fly?"* question than ducted fans.

MotoCalc 5.0 also adjusts its predictions for elevation above sea level, something that might be useful for those who live at high altitude. Another nice feature is that you can customize the output so that unwanted data are not displayed. The sort utilities have also been greatly improved.

A free, 30-day evaluation copy of MotoCalc can be downloaded from the Capable Computing website. Check its website (http://www.motocalc.com/) for ordering details.

This is not intended as a full-blown review of these two useful tools, but I'm sure some of you are wondering about their relative merits. In my view, both have their particular strengths. MotoCalc provides a great deal of information, and since it asks for more detailed descriptions of the aircraft and hardware being analyzed, one can expect that the data will be a little more accurate. ElectriCalc is my personal favorite by virtue of its intuitive layout and ease of operation. After all, I really only want to get an idea of the expected performance of a new design; I'll check out the most promising combinations in actual flight testing. In the end, which program you choose will depend on your personal needs and tastes. One thing is certain: it's hard to go wrong with either.



In addition to providing more data than you could ever need, MotoCalc provides easy-to-understand performance graphs that help you to see how your electric model will fly. Here, the relationship between speed and prop efficiency is demonstated.

more on DrawingBoard, refer to Gerry Yarrish's review in the December 1998 issue of *Model Airplane News*. Other CAD systems offer this capability as an optional add-on; consult the documentation that came with your software for details.

PLOTTING YOUR MASTERPIECE

Now that I have my plans drawn, how can I get a good full-size copy?

This is the one great problem with designing large model airplanes on a computer monitor; eventually, you'll want to produce a full-size plan, and most of us are limited to an ink-jet printer that handles nothing bigger than legal paper. Depending on your CAD system, there are two options. The first is that some home CAD programs like DrawingBoard allow you to "tile" print the plan; the image is printed on a series of sheets, each with registration marks at each corner, so that you can accurately assemble and tape them into a full-size plan. If you like, this plan mosaic can then be reproduced on a large-format photocopier at your local copy store. Personally, this seems like a lot of work to me.

One nice fringe benefit of my job is that I have access to my company's large-format ink-jet plotter, which allows me to print out plans up to 36 inches wide and any length I need (as long as I provide the Mylar). Don't despair or curse me, though, because you have access to the same capability at many copy stores. Generally, you just need to save your plan as a DXF file, which you can take to the store on diskette or send via modem as a file attachment. Call your local copy stores to ask about specific file requirements and costs. Costs for this service vary widely, and I wouldn't overlook asking technical friends in your club if they have access to a large-format pen plotter. Free is hard to beat.

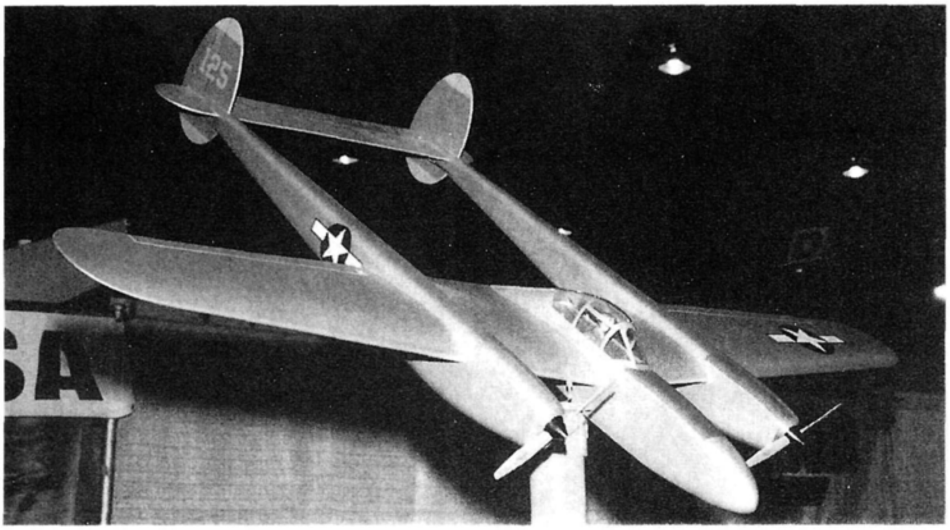
That's about it for this month. Please keep your questions and suggestions coming in. This column is for your benefit, and the future direction is primarily set by the overall tone of the mail. Please send email directly to jimryan@sprintmail.com, as this saves time forwarding it. As always, snail mail inquiries should include an SASE and be addressed to 6941 Rob Vern Dr., Cincinnati, OH 45239.

As I write this, building season is swinging into gear, and I have some ambitious goals for the long winter months. So much of the enjoyment I get from this hobby is derived from designing and building that I honestly wonder how people who never build stay interested. Successfully flying a model that you built with your own two hands is a great experience, but there is nothing quite like the thrill of test-flying a model that you designed from the ground up. So go for it!

**Addresses are listed alphabetically in the Index of Manufacturers on page 134.*

CURRENT THOUGHTS *by Greg Gimlick*

Multi-Engine Wiring, Part 1



Jim Ryan's S-400-powered P-38 uses a series circuit and 16-600mAh cells.

WHEN I FIRST got into electrics, I didn't give a lot of thought to why I chose this route or to the many benefits I would come to appreciate, but I did think about doing a multi-engine airplane. For some reason, when we go to a flying field, we are drawn to models that have more than one engine, even though there may be many wonderful single-engine scale planes present. The first time I attended KRC, I was awed by the number of multi-engine models there and knew I had to have one, even though I had never built one during all my years of flying. The main reason it is possible now is the absolute dependability of electric motors. Think about it for a minute: why haven't you ever tried one? For me, it was the thought of trying to get two or more engines running well and synched with each other, but electric motors will absolutely be in tune with each other as long as they are running.

For those of us who are new to this, we should spend a bit of time looking at the basics of wiring before we get too excited and jump ahead. I'll also begin with a disclaimer: we are not designing and building space vehicles for NASA, and this is not meant to be a course in electrical engineering, so please accept that we will be using some widely accepted rules of thumb. These rules are close enough for our purposes. (They haven't been worked out to the 10th decimal place in calculation, but they work and work well, so we won't debate a 0.00056 resistance difference here and there.)

To begin, there are two types of circuits: series and parallel. If two things are wired in series, the positive (+) terminal is connected to the adjoining negative (-) terminal of a source or load. A simple example is shown in Figure 1—two Ni-Cd cells. This is what most of us are used to seeing because our battery packs are made of a number of cells wired in series to obtain the voltage we want. Our receiver batteries usually have four cells in series to make a 4.8V receiver pack. We'll make the assumption that all Ni-Cd cells represent 1.2 volts each, and in the case of our examples, they are 2000mAh cells. In Figure 1 we have two cells in series to make a 2.4V pack with a capacity of 2000mAh. When we get to wiring a load (motor) into the system, we will assume only 1 volt per cell under load.

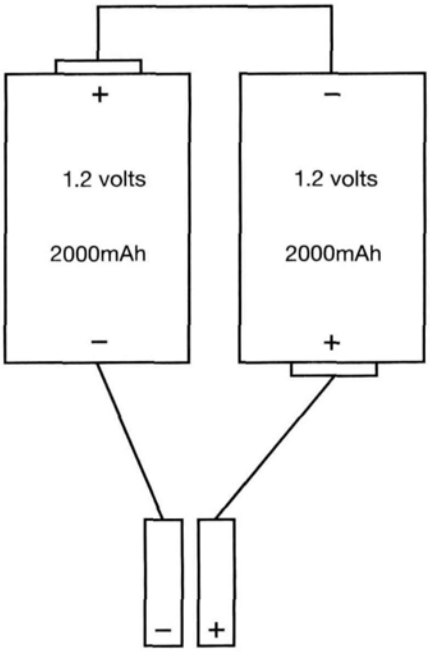


Figure 1. This series circuit equals 2.4 volts and 2000mAh.

Figure 2 shows two cells wired together in a parallel circuit with the positive wired to the positive and the negative wired to the negative. This results in a pack that has only 1.2 volts but now has a capacity of 4000mAh. From these two examples, we can draw the following conclusions:

1. When cells are wired in series, the pack's total voltage is the sum of the number of cells multiplied by 1.2 volts, and the capacity is the same as the rating of one of the cells; in our example it's 2000mAh and 2.4 volts.

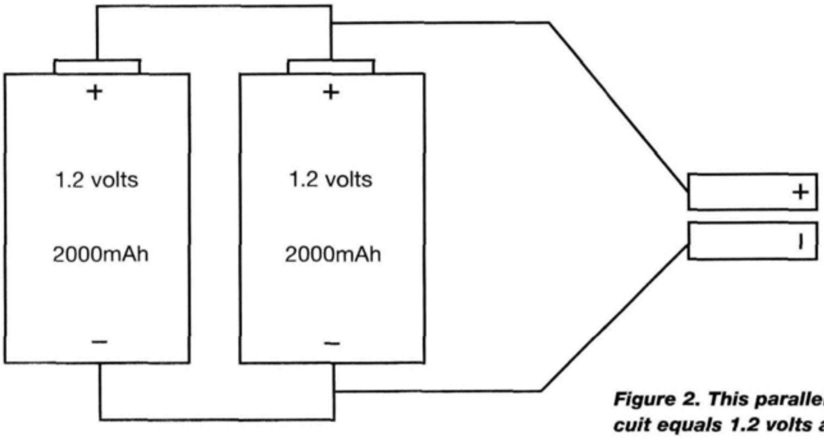


Figure 2. This parallel circuit equals 1.2 volts and 4000mAh.

2. When cells are wired in parallel, the pack's total voltage is equal to the voltage of one cell, but its capacity is the sum of the individual cell capacities; in our example it's 1.2 volts and 4000mAh.

Perhaps you have seen this done in golf carts that require 6 volts but very high capacity. They use two, very high-capacity 6V batteries and wire them in parallel to maintain the 6 volts, but have double the capacity so you aren't left out on the course. If you were in the military, you have probably seen it on the infamous deuce-and-a-half trucks. My van has an auxiliary battery that is wired into the van's system in this way, too; most electric wheelchairs and scooters are also wired in this way. If we could handle the weight of such a system in our planes, we would be able to enjoy some really long flights, but unfortunately, it isn't a solution for us under most circumstances.

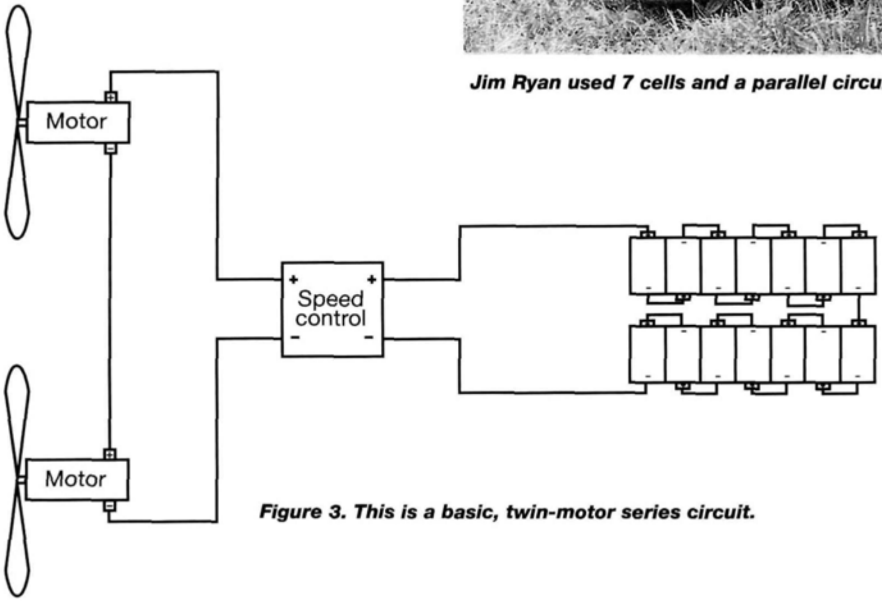


Figure 3. This is a basic, twin-motor series circuit.

Let's wire up a twin-engine plane with electric motors. For the purpose of clarity, I'll eliminate the switch harness, which in most cases is located between the battery and the speed controller. Keep in mind that if you use switches and fuses with a BEC, you should put them between the motors and the speed controller so you don't lose power to the controller and, subsequently, the radio, if the fuse blows. Now that we have all of that straight, let's assume our motors will require 7 volts (remember, we said we'd use 1 volt per cell for simplicity under load) and 25 amps. Here is a rule of thumb:

If two motors are wired in series, each one will see half of the total voltage of the battery pack, and the pack will see the current demands of one motor. Because of that, we'll need two 7-cell packs wired together in series (or a 14-cell pack) so that the motors will see 7 volts, or half the 14-cell pack's voltage. Figure 3 shows how the two 7-cell motors would be wired in series with the rest of the system. Notice that the positive wire goes from the positive output on the speed controller to the positive brush of the motor. Another wire goes from the negative brush of one motor to the positive brush of the next motor, and, last, a wire goes from the negative brush of the last motor back to the speed control into the negative output connection.

Jim Ryan used 7 cells and a parallel circuit in his Catalina.

Figure 3 shows that the two 7-cell motors are in series and connected to the battery pack through an electronic speed control. Each motor will see half the pack's voltage (7 volts), and the speed control and battery will see the current draw of only one motor, or 25 amps.

Series circuits for twins are probably the most common, but there are times when you may not want to carry the extra weight of all those cells, as in the case of some of the Speed 400 multi-engine projects. What to do? We'll wire the system in parallel, that's what. When using parallel systems, each motor will see the voltage of the entire pack, and the pack and speed controller will see the combined current draw of both motors.

Figure 4 shows how to wire two 7-cell motors in parallel. Since each motor will see the total voltage of the pack, we need only the 7 cells. Notice that the positive wire goes from the speed control's positive output to both of the motor's positive brushes, and the negative side feeds both of the negative brushes, so the motors are actually wired to the controller instead of to each other in the circuit. In this example, the motors and speed control would see 7 volts, and the controller and pack would see 50 amps from the motors. I think you can see that in this example we'd prefer the series circuit for better duration, but in a Speed 400 plane where the motor only draws about 10 amps, it can work fine and allow a larger capacity battery rather than more cells to be used.

You may be wondering why you also see many Speed 400 planes using series circuits. Well, there are individual applications and experience tradeoffs. In my converted Sig Hummer, I had a choice of a 7-cell pack of 1700SCRCs that weighed 15 ounces (about 2 ounces per cell) for the parallel system or a 14-cell pack of KR600AE cells that weighed 9 ounces (0.63 ounce per cell) for the series system, so a weight and duration tradeoff is one consideration. The current to the pack and controller would be about 10 amps in the series circuit, or 20 amps in the parallel circuit, and in both cases, my speed control could handle the voltage and current, so it came down to making some duration and weight decisions.

To see how I came to my decision, we'll employ some numbers generated from ElectriCalc, which is my particular electric setup simulator of choice, but use whichever software or pointy-pencil method you prefer. Here are some of the numbers generated:

	Series setup	Parallel setup
Battery amps	9.3	9.6
Motor amps	9.3	9.8
Plane weight (oz.)	34	39
Wing loading (oz./sq. ft.)	23.1	26.5
Stall speed (mph)	13	20
Minutes at full throttle	3.7	5.7

There's nothing really shocking about any of these values, and the current is what I expected (remember that the battery current is what the battery sees along with the controller and is doubled in the paral-

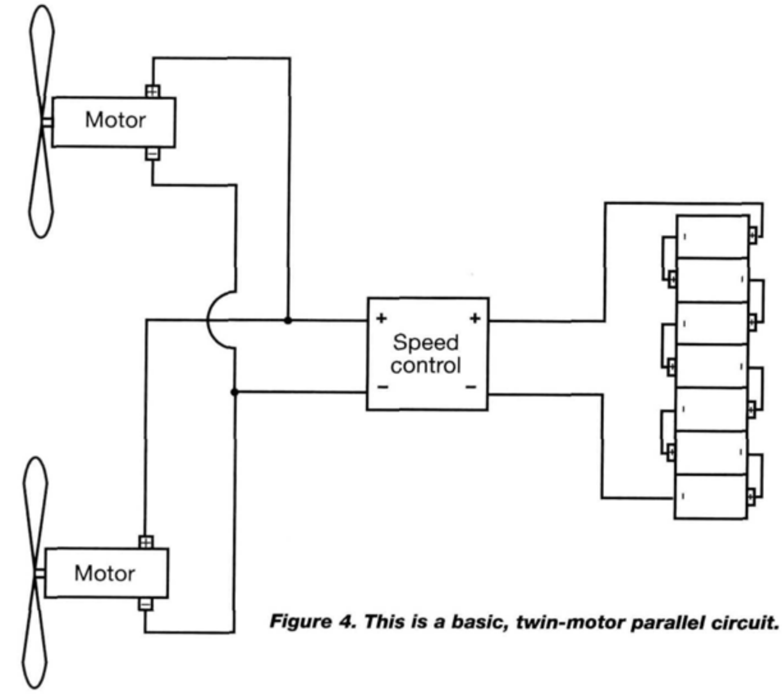


Figure 4. This is a basic, twin-motor parallel circuit.

Marc Thompson's CL-415 uses a series arrangement to power the two Astro 05Gs.

lel circuit). Performance numbers for rate of climb and climb angle were very similar. On first look, we might be tempted to just see that duration is two minutes longer with the parallel setup and to just go with that decision right away, but there's more here that merits attention. The wing loading also went up about 15 percent, but the biggest jump was in stall speed, which means a tough launch or using a bungee, and I like to be able to just toss my plane into the air. I chose the series setup, and it has done very well, but a parallel setup would work, too, and it is used in many of the imported twin-engine models seen in the catalogs of Hobby Lobby* and Unbeaten Path Imports*. Jim Ryan tried both setups in his P-38 design and decided that a series setup performed better and was easier to launch. But when he built a Hobby Lobby Catalina, he used two Speed 400 motors in parallel. In my OV-10, I originally had set it up with two geared ferrite motors in parallel, and it drew 40 amps from the 12-cell pack, but the power was marginal for what I wanted, so I replaced them with two Astro 05Gs in series on 16 cells. I picked up about 10 ounces overall, but performance is far better, and the current is lower at about 25 amps. Since I had strained my plane through a tree right before doing this, I was also afforded the opportunity to add a couple of wing bays to help offset the increase in weight incurred by adding the extra cells. Both setups flew the airplane, but the higher-quality motors and lower current overall seemed to be the better match and more than made up for the weight gain.

Marc Thompson's Canadair CL-415 demonstrates truly outstanding performance using two Astro 05Gs spinning counter-rotating 11x7 Zinger props on 16 cells. All-up weight of the 71-inch beauty is only 6¾ pounds, and to watch it tumble end over end is inspiring, to say the least.

That's about it for this month, but there's a lot more to cover, so I'll be back next month for part two of multi-engine projects and a look at some of the more hybrid solutions to multi-motor setups.

Write to me at 1016 Camberley Dr., Apex, NC 27502-8107, or email at greggimlick@mindspring.com.

**Addresses are listed alphabetically in the Index of Manufacturers on page 134.*

The Builder-of-the-Model Rule

EACH YEAR AT about this time, I hear more gossip than I know what to do with. (I figure it has to do with the upcoming winter weather.) The latest topic involves modelers apparently cheating at scale events, such as the AMA Nationals, Top Gun and the Scale Masters, specifically when it comes to the builder-of-the-model (BOM) rule.

Just what every scale modeler needs: a B-17 desk/alarm clock. Neat gift idea, too!

I want to go on record and say that I *seriously doubt that any modeler would* knowingly cheat in competition. In this litigious age, perhaps our definitions of cheating and interpretations of rules have become confused. Here's a hypothetical situation to ponder:

Let's say a fledgling scale modeler (we'll call him "Joe") purchases a very complex P-61 Black Widow kit and starts to build it. His building skills are excellent, but his flying skills are limited. He diligently continues the project, but after he has framed up the fuselage and wing, a friend convinces him to stop the project and switch to a simpler one that will guarantee success.

With his new project under way, Joe exchanges his P-61 for some needed merchandise from an advanced modeler who is looking for a P-61 project. Both are happy and walk away satisfied with the deal.

Two years later, the two modelers meet at a contest; Joe is flying his Piper Cub, and the other modeler is flying the P-61 (purchased from Joe in a framed-up condition). Joe protests to the CD that the other modeler is not "the builder of the model" and should be disqualified. Is Joe correct, or is he confused? I think he's confused. How much building do you have to do to be considered the builder of the model?

AMA competition regulations state, "The builder and flier of a scale model shall be one and the same person. There shall be no team entries. The Contest Director will make every reasonable effort to assure himself that each flier has completely constructed the model(s) he uses in competition, including the covering, where used, with construction to be interpreted as the action required to complete a model with no more prefabrication than the usual kit. Kits containing a large amount of prefabrication are permissible as long as the final assembly of the parts and covering and/or the final assembly of the parts and covering and/or painting are done by the builder. Models that are completely prefabricated and require only a few minutes of unskilled effort for their completion shall be excluded from competition."

I am not completely sure that the AMA competition regulations are definitive today. They were written at a time when fiberglass fuselages and other advanced technologies used in today's kits did not yet exist.

The work required to built an all-wood Dave Platt* kit is considerably different from what's required to build a similar-size, foam and fiberglass Yellow Aircraft* kit. And again, both of these kits are quite different from what you get in an Aerotech Models* kit. All its major components come built, and all the surface details (panel lines, screws and rivets) are molded into the model. Trust me: there is nothing easy about building any of these products. They all require lots of effort.

I do not think there is fault with the AMA definition of "builder of the model," but perhaps it needs to be somewhat updated because of all the technological advances we enjoy today. I work on the premise that I must do 51 percent (the majority) of the work on my competition aircraft to stay within the AMA's builder-of-the-model guidelines. If the AMA would add such a simple statement to its definition of the BOM rule, it would take the guesswork out of whether a model is legal. A model is legal if its builder did 51 percent of the work—simple! This would also allow modelers to help one another build their aircraft without fear of being challenged as "cheaters." Now, let's think of what exactly constitutes 51 percent of the effort. Remember the old saying, "When a model is completely built up, it is only half done—finishing, painting and weathering make up the other half of the job!"

Here's something else to think about. In this computer- and CAD-oriented world, a modeler spends the better part of the year researching, documenting and then drawing the plans for his model using a CAD program. He puts the CAD file on a disc, hands it to someone with a laser cutter and has all the parts cut out for him to take home and build. Is this modeler in violation of the BOM rule? A 51-percent rule would say he's legal, yet there are those who are dead set against this type of construction.

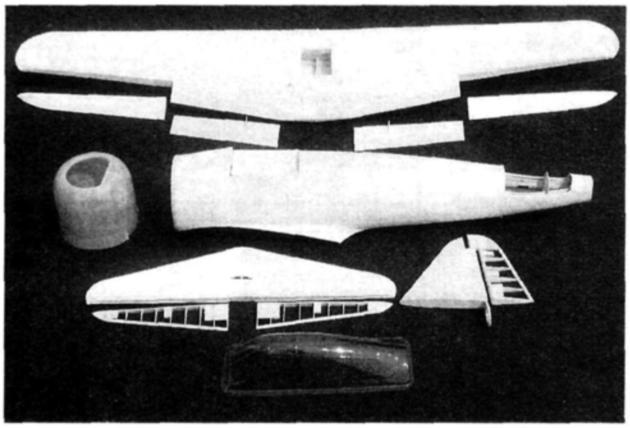
During the building months ahead, consider these ideas, and let me know what you think.

WISE OWL WORLDWIDE PUBLICATIONS

I am constantly searching for scale documentation and books on aviation history. My library contains a great deal of information on aircraft that would make great models. One of the best sources for WW I aircraft books is Wise Owl Worldwide Publications*.

This company has been run by Joe and Erika Daileda for the past 28 years and continues to expand its aircraft

Looking for excellent WW I scale documentation? Try the books offered by Wise Owl Publications. They are filled with 3-views and rare photographs.



I bought this Zero at a model auction. It is partly built up, but more than 51 percent of the work is left to bring it to a competitive level of completion.

book line. Currently, Wise Owl offers a complete selection of the Windsock Data Files that focus specifically on WW I aircraft. Each booklet is specific to one aircraft, is printed on heavy, glossy paper and includes numerous black-and-white photos, 3-view drawings and color profiles. If you are considering a WW I project, these are excellent reference booklets.

Wise Owl also offers many magazines and books from Europe that might not be readily available in bookstores. Give Wise Owl a call and check out its catalog.

12 O'CLOCK HIGH

If you are looking for a gift that is different yet geared to the model airplane enthusiast, I know where to send you: Vaquero Canyon Specialty* has really neat airplane alarm, wall and desk clocks. I fell in love with the B-17 shown on the previous page. If you're an aviation buff, you really do have to have one.

The model on the clock base has an 18-inch wingspan, is 13 inches long and 8 inches high. It is very accurately detailed and sits on my office desk as a great conversation piece. Operating on four "AA" batteries, the propellers turn, and it has a sound system with engine and gun noises. Send them an SASE, or email them at wranglerRS@aol.com for a catalog and price list, and mention that you saw it in the "Scale Techniques" column.

TOP FLITE U.S. WW II PILOT

Top Flite* has little that I don't like. Its new 1/7-scale WW II pilot figure is a neat cockpit accessory that is very light. The pilot figure's body parts can be assembled in various positions to custom fit just about any cockpit layout.

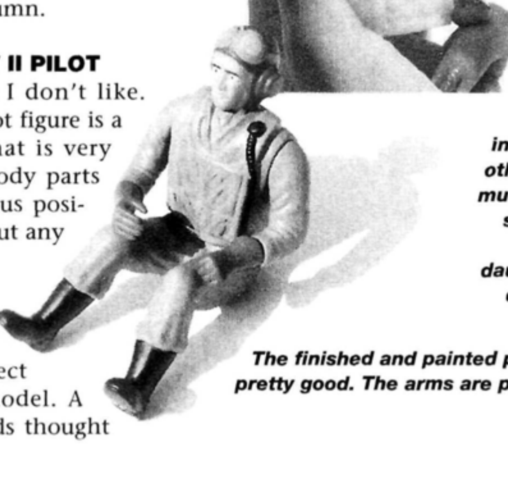
I use two Top Flite pilot figures in my Midwest AT-6 Texan, and I think they are the perfect size and shape for my model. A few of my modeling friends thought that cutting and gluing a pilot figure together was too difficult; it's really very easy, and the steps are part of this month's column.

Start by making sure that you have all the parts (10 in all) and determine where each part should fit. Use a sharp pair of scissors or a hobby knife and trim the hands, leaving a ¼-inch lip to be inserted into the wrist opening. Once trimmed, fit the hand into the arm and rotate the hand until it fits properly. Cut the opening in the upper torso where the arm will fit, then gently rock the arm back and forth until it pops into the opening. Continue this cut-and-fit procedure for all the body parts until you have a complete pilot figure.

Assemble the pilot dry (no glue), and look it over. If you are satisfied, take it apart and paint it, following the guidelines provided with the pilot figure. Before you paint, though, wash the parts with soap and water to remove any oil or mold-release agent left on it. I used Testors* water-based enamels to paint my figures, and I think the results look very fine. I also filled the legs and upper torso with cotton for rigidity before I glued the parts together with PFM*. That's it! A nice, simple project, ideal for a weeknight work session.

Top Flite's new 1/7-scale pilot figure is light and easy to build and paint.

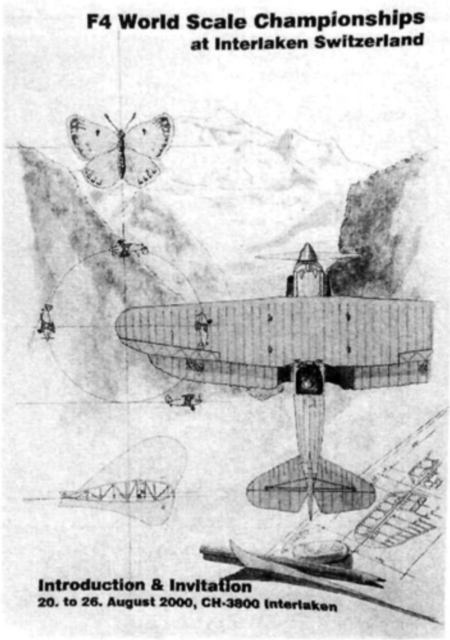
The openings in the torso and other body parts must be trimmed so the parts fit properly. My daughter Kristen demonstrates.



The finished and painted pilot looks pretty good. The arms are positionable.

FAI WORLD SCALE CHAMPIONSHIPS

Stan Alexander sent me a memo concerning the next FAI World Championships to be held in Interlaken, Switzerland, August 20 to 26, 2000.



In the year 2000, the FAI World Scale Championships will be held in Interlaken, Switzerland. We need a strong team. Why not try out for the FAI team at next year's AMA Nats?

As the story goes, if you are a competitor, "You cannot get there from here" unless you qualify for the U.S. team at the AMA Nats to be held on July 4 to 10, 1999.

Stan estimates that at least 30 full international teams will attend the World Champs for each class of the competition. AMA rules and FAI rules do not agree in many areas, so it is in your best interest to contact the AMA if you plan to compete in the qualifier next summer. Team USA can use all the help it can get to be competitive in the World Championship. The only way to ensure that we have a strong team is to have as many competitors as possible try out for the team. Go for it!

It should be around the holidays when you read this, so I would like to wish all of you a wonderful holiday season. If you see me at a trade show, please stop and say "Hello." Have a wonderful scale New Year.

**Addresses are listed alphabetically in the Index of Manufacturers on page 134.*

PRODUCT NEWS

Latest product releases

INFORM YOUR CUSTOMERS! **Model Airplane News is interested in showing our readers your new products—here in Product News. If you'd like to see your products here, send us a clear photo and a press release that provides information about your product! We'll publish as many as space permits.**

Send your announcements to: Product News, Model Airplane News, 100 East Ridge, Ridgefield, CT 06877-4606 USA.

O.S. ENGINES

.25 LA

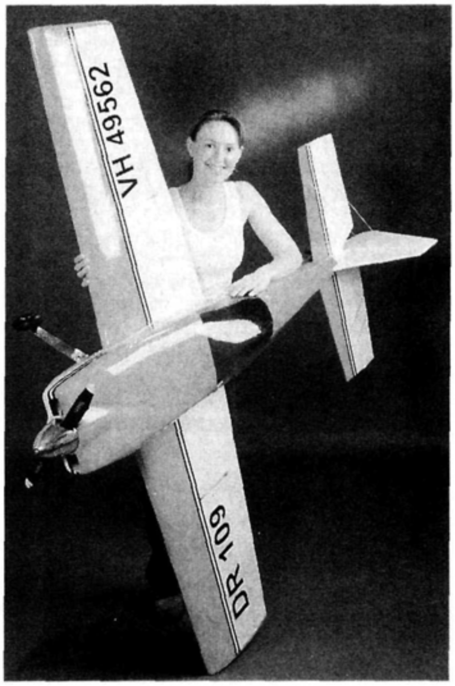
With all the performance features of the .40 and .46 LA engines, the new .25 LA is powerful, yet affordable. In addition to the remote needle valve mounted on its backplate, the .25 LA also has coarse threads and an O-ring seal on the needle valve, an extra-long crankshaft and flat aluminum washer for more secure prop nut engagement, a vertical fuel inlet, more cooling-fin area and thicker webbing on high-stress areas. It comes with a muffler and a 2-year warranty.

Part no.—OSMG0025; **price**—$94.99.

O.S. Engines; distributed by Great Planes Model Distributors, 2904 Research Rd., Champaign, IL 61826-9021; (217) 398-6300; fax (217) 398-0008.

BIG ED'S HOBBIES

DR 109



This 86-inch-span, 30-percent-scale model is fully aerobatic and can be powered with a 1.50 2-stroke or more powerful engine. All kit parts are laser cut, and the 109 was designed with the builder in mind. It comes with full-size, CAD-designed plans, photo-illustrated instructions, a fiberglass engine cowl, clear vacuum-formed canopy, formed aluminum landing gear and all pushrods, hinges and other necessary hardware. Replacement parts are also available.

Price—$239.

Big Ed's Hobbies, Box 1555, Bathurst, NSW 2795, Australia; 011-61-02-6331-6407; fax 011-61-02-6332-4405; email: biged@ix.net.au; website: www.hobbynet.com.au/biged/index.html.

ANCHOR SEAL INC.

Anchor Bond 2-Part Epoxy

Anchor Bond comes in a pump bottle that helps to achieve the correct mix of resin and curing agent every time. This epoxy has an extremely low viscosity, and this allows it to penetrate more deeply into wood, ensuring strong, semi-rigid bonds at critical joints. A wide choice of cure speeds is available.

Anchor Seal Inc., 16 Riverside Ave., Danvers, MA 01923-3281; (800) 669-5217 or (978) 774-5217.

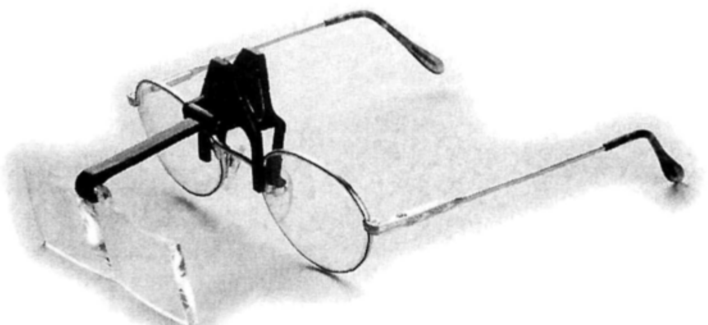
SKS VIDEO PRODUCTIONS

Top Gun '98 and 13th Annual Bay of Quinte Jet Rally

Two new videos from SKS feature the 10th anniversary Top Gun and one of the largest jet events in Canada. The 118-minute Top Gun video features Dave Platt's T-28, Eduardo Esteves' Spacewalker and Jeff Foley's Me 109; the Bay of Quinte video is 80 minutes long and features Stephan Frappier's F-20 Tigershark, Bob Boswell's A-4 and Yves Duchesneau's Turbo Cyclone and MiG 21.

Price—$19.95 (plus $3 S&H) per video.

SKS Video Productions, R.D. 1, Box 264, Pine Rd., Abbottstown, PA 17301; (800) 988-6488 or (717) 259-7193; fax (717) 259-6379; email: sksvideo@cyberia.com; website: www.yorkpa.com/sks.



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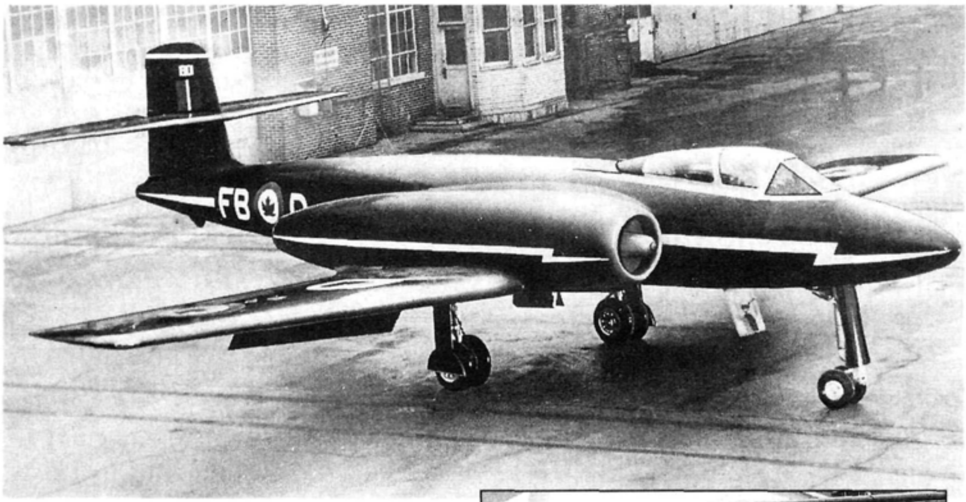
NAME THAT PLANE

Send your answer to *Model Airplane News*, **Name that Plane Contest** (state issue in which plane appeared), 100 East Ridge, Ridgefield, CT 06877-4606 USA.

Can you identify this aircraft?



The winner will be drawn four weeks following publication from correct answers received (on a postcard delivered by U.S. mail) and will receive a free, one-year subscription to *Model Airplane News*. If already a subscriber, the winner will receive a free, one-year extension of his subscription.

Congratulations to 11-year-old Lane Gorst of Myrtle Point, OR, for correctly identifying the November '98 mystery plane. Photographed at the 1997 EAA Aviation Expo at Whitman Field, Oshkosh, WI, the Acro Sport I biplane was designed by EAA founder Paul Poberezny. Paul specifically designed the biplane as an aviation project for students to build for educational purposes. He also hoped that this experience would persuade some students to pursue a career in aviation. The Acro Sport I has a 20-foot wingspan with 108 square inches of wing area, is 17 feet long and weighs approximately 710 pounds (empty) with an 85hp engine. The prototype (pictured here) first flew on January 11, 1972, only 352 days after aircraft design had begun. The biplane is built from welded steel tubes and features wooden wings and fabric covering.

The prototype is powered by a 180hp 0-360 4-cylinder Lycoming engine and is currently in the EAA Museum's aircraft collection.

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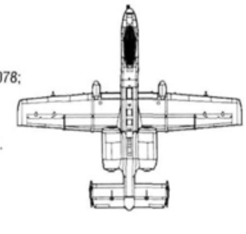

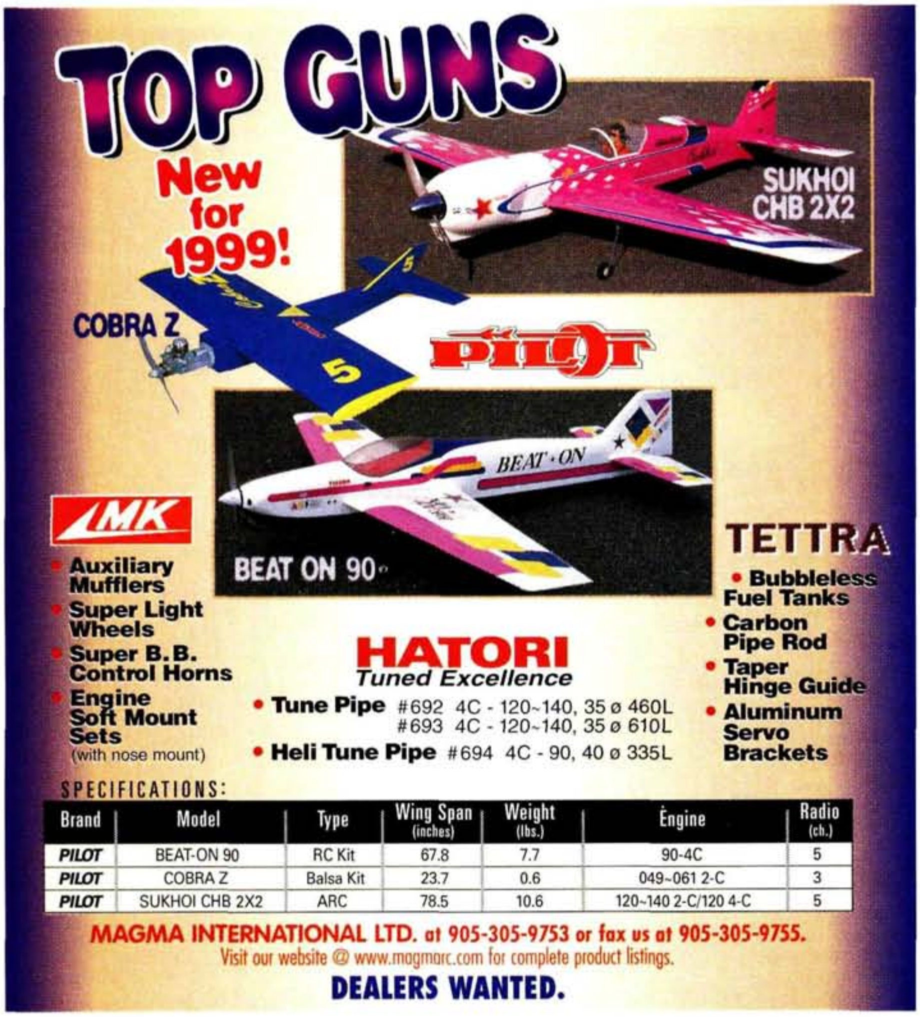

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BY ALEXANDER VAN DE ROSTYNE

Pixel; the World's Smallest R/C Helicopter

Who hasn't dreamt of flying an R/C model in the living room, or having one that loops above the kitchen table and drops a sugar cube into your coffee with just a flick of the transmitter switch?

In 1996, European modeling magazines started reporting on a new wave in our hobby: slow flight. Some very inventive people had broken all the rules with planes that weighed no more than 100 grams or so. They called it "slow flight" because the planes flew slower than walking speed. I researched the new technologies and learned about 2.4-gram proportional servos, 10-gram propulsion motors, 0.5-gram speed controllers and 4-gram receivers. Most of these components were marketed by WES-Technik.

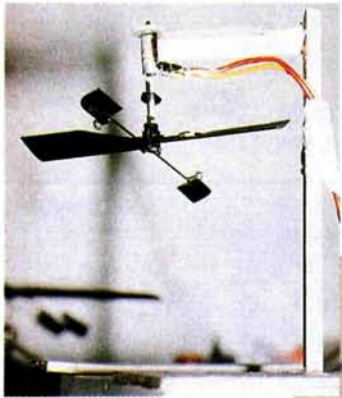
Pixel IV waits to catch a goldfish (or vice versa).

As a veteran modeler and R/C helicopter freak, I started dreaming about a tiny R/C helicopter. I picked up the phone and called Walter Scholl, who heads up WES-Technik. An idea was born, and about a year and a half later, I had managed to design, build and successfully fly four prototype Pixels.

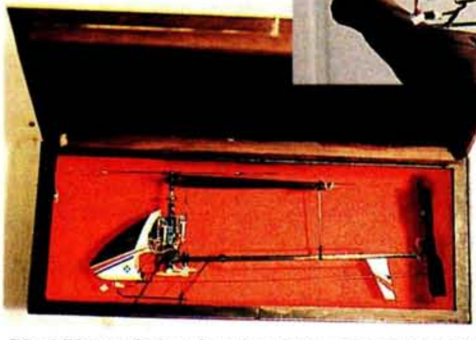
The Pixels are all my own design. All the mechanical pieces, including rotor head, swashplate, etc., are handmade. The tools I used are plain, standard stuff: mainly a Dremel, a hobby knife and some files. Roughly 99 percent of the frames are carbon. The first blades were balsa covered with fiberglass; now, they are fully carbon molded and the tail-rotor blades are carbon, too. Most of my time went into designing the rotor head and transmission system. It was crucial to determine the correct combination of rotor dimensions (span and chord), pitch, rpm, gear reduction ratio, motor and battery selection.

It may surprise you how easily I went from 125 grams for Pixel I down to 59 grams (2.1 ounces) for my latest design, Pixel IV. The biggest challenge was to get maximum lift with minimal power input. The 8-cell, 50mAh packs don't perform very well because the internal resistance is quite high, and I draw up to 1 amp out of them. So I needed to limit power consumption. At 59 grams, Pixel IV can fly for about 1½ minutes; with a larger battery and at 70 grams, it can fly for 3½ minutes.

Helicopter rotor heads are very complicated units, and just making the big ones smaller does not work. In standard R/C helis, much of the stability is accomplished by adding weight—not something you want to do when you're trying to build as small as possible. I froze the design around a dual-flapping, fixed-pitch, Bell-bar, Hiller-paddles design. The fixed-pitch technology works great for indoor applications. The helicopter does not yo-yo up and down because there are no wind gusts. And with some tail-rotor mix on my Futaba 9ZAP unit, the tail is locked in. You may be surprised to know that there is even a piezo gyro on board.



A typical test configuration. A tail rotor is mounted on a digital precision scale.



Pixel IV travels in a handmade wooden jewelry box.

The Pixel has a separate motor for the tail rotor. The tail is controlled by changing the rpm of the motor. This reduces enormously the complexity of the tail's mechanics (no gears or transmissions from the front to the back of the helicopter) and, even more important, makes it much lighter.

Mathematical models indicate that fat houseflies cannot fly, yet I go crazy when they buzz around my head. The point is that whatever the mathematics say, you have to give it a try. While testing blades for the Pixel, I learned that wider, shorter blades seem to perform better than narrow, long ones. This goes against all the theories, but I can't help it. Overall, longer blades (given a certain width) always score better. However, a small helicopter needed to have short blades, so I made them wider. The highest efficiency I got was with elliptical carbon blades. I now need no more than 4 watts to produce the hovering lift force.

Pixel IV in the author's hand. At 59.8g, it flies like a "full-size" R/C heli.

One of the reasons that Pixels fly so well is that they have only about half the disk loading of standard R/C helicopters. For Pixel IV, that is around 10 grams per square decimeter; for any other helicopter I know, it is in the 20s and more.

What next? I am trying to design a version that weighs less than 50 grams and can fly for more than 5 minutes. In the meantime, at least one of my dreams has come true: I actually did drop a sugar cube in my coffee with Pixel! Check it out in a video clip on www.planetinternet.be/pixel. See you there!